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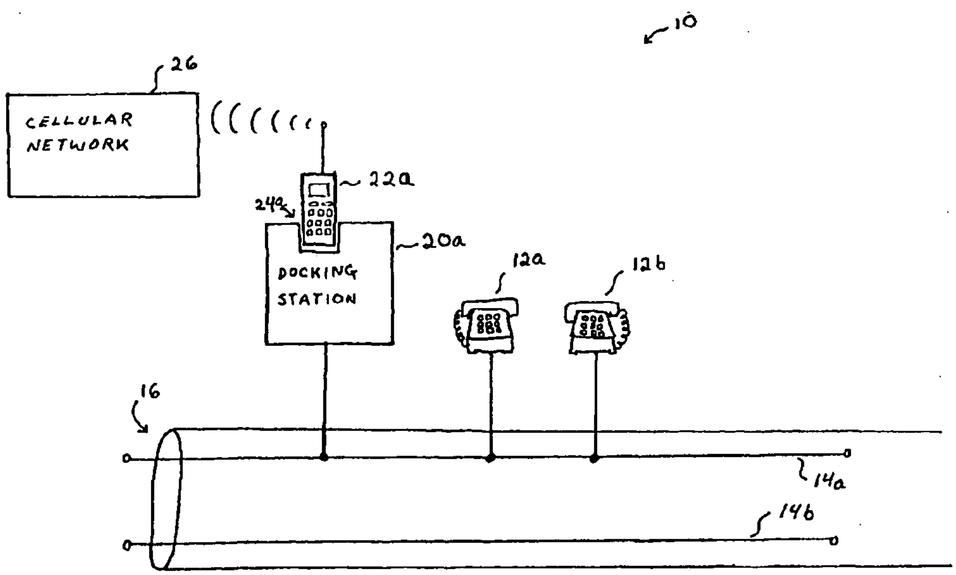

(57) Abstract: A system for providing cellular network (26) access to a land-line telephone connected to premises wiring (16) having a first telephone-line and a second telephone-line includes a land-line interface for connection to at most the first telephone-line of the premises wiring. The system also includes a cellular-telephone interface (20a) for connection to a cellular telephone (22a) having access to the cellular network (26), and a controller establishes an audio connection between the cellular-telephone interface and the land-line interface in response to status information provided to the controller by the cellular interface and the land-line interface.

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CELLULAR TELEPHONE DOCKING STATION

REFERENCE TO RELATED APPLICATIONS

This application claims priority from U.S. Provisional Application Serial No. 60/174,517, filed January 5, 2000, the contents of which are herein incorporated by reference in their entirety.

FIELD OF INVENTION

This invention relates to cellular telephony, and in particular, to the interfacing of cellular networks with land-line networks.

BACKGROUND

When erecting a structure intended for human occupancy, it is a customary practice to incorporate telephone wiring into the walls of the structure. The underlying assumption driving this practice is that virtually any such structure will ultimately be connected to a land-line telephone network. Since the labor cost of snaking telephone wiring through existing walls is so high, it makes economic sense to incur the cost of wiring a structure up front rather than adding the telephone wires after the fact.

In some cases, however, it also makes economic sense to refrain from connecting a structure to a land-line telephone network. For example, in a vacation home, the telephone may be used sporadically for only a few months of the year. For the remainder of the year, monthly telephone access fees continue to accrue, even though the telephone may be idle.

The telephone wires used to wire most structures have four separate conductors for supporting two separate telephone lines. Thus, virtually all new construction comes pre-wired for two separate telephone lines. Nevertheless, in many cases, the second pair of conductors remains idle because of the need to pay additional telephone access charges for the second line.

The advent of cellular telephony has provided some relief from the foregoing difficulties. In the case of a vacation home, one can forego connecting the premises wiring to a land-line network altogether. Instead, one can obtain telephone service on an as-needed basis by simply bringing one's cellular telephone to the vacation home. In the case of a home requiring a second line, one now has the alternative of using cellular telephone as the second line.

One disadvantage of using a cellular line in the foregoing manner is that the cellular telephone must be readily available at the moment one wishes to place or receive a call. Unless one is willing to carry the cellular telephone all over the house, it may be necessary to rummage through several rooms within the house to locate the cellular telephone. A second disadvantage of using a cellular line in the foregoing manner is that devices such as fax machines, speaker phones, answering machines, and data communication modems cannot readily be connected to the cellular line.

SUMMARY

The invention provides for the connection of cellular telephone to premises wiring thereby enabling the use of conventional telephones connected to the premises wiring for communication over the cellular network.

A system according to the invention includes a land-line interface connected to premises wiring having first and second telephone lines. The land-line interface provides a connection to only the first telephone-line of the premises wiring. This leaves the second telephone-line free for other uses.

The system also includes a cellular telephone interface that can connect to a cellular telephone having access to a cellular network. In one embodiment, the cellular-telephone interface connects to a cellular telephone by providing electrical contacts that engage with corresponding electrical contacts on the cellular telephone. However, the cellular telephone interface can also connect to the cellular telephone by a wireless link.

The land-line interface and the cellular-telephone interface are linked by a controller that establishes an audio connection between the cellular-telephone interface and the land-line interface. The controller does so in response to status information provided to it by the cellular interface and the land-line interface.

In one embodiment of the invention, the controller can include an input port for receiving a sequence of tones from the land-line interface. The sequence of tones can include a first sub-sequence indicative of a telephone number, followed by a second sub-sequence for instructing the cellular telephone to send instructions representative of the first sub-sequence to the cellular network. The controller also includes a control signal output through which it transmits, in response to the sequence of tones, a control

signal to the cellular telephone. The control signal represents instructions causing the cellular telephone to establish a connection to the telephone number indicated in the first sub-sequence of tones.

The system optionally includes a switch having a first setting for selecting the first telephone-line and connecting the land-line telephone to the land-line interface, and a second setting for selecting the second telephone-line and disconnecting the land-line telephone from the land-line interface. However, where the land-line telephones are two-line telephones, such a switch need not be separately provided. Similarly, if the second telephone-line is not connected to a land-line network, a switch is not necessary since all communication will take place through the first telephone-line.

The land-line interface can be a subscriber-line interface circuit, or "SLIC". The SLIC can communicate audio information through analog input and output audio ports connected to corresponding analog ports on the cellular-telephone interface. The audio input port of the SLIC can also be connected to an analog output audio port of the controller. This allows the controller to synthesize a tone and inject it into the premises wiring. The analog audio output port of the SLIC can also be coupled to an analog audio input port of the controller, thereby enabling the controller to receive DTMF tones from the premises wiring.

In one aspect of the invention, the telephone communicates over a LAN. When this is the case, the system includes a network interface to a local-area network with which the land-line telephone is in data communication.

The cellular-telephone interface typically communicates with the cellular telephone by securing the cellular-telephone to an electrical contact disposed in a docking receptacle. However, a cellular telephone can be docked, in a logical sense, whenever it is in communication with a docking station, regardless of the manner in which communication takes place.

In one embodiment, communication associated with docking is established over a short-range radio link. In this case, the cellular-telephone interface includes an antenna, an RF transmitter coupled to the antenna for providing a signal to the antenna for reception by the cellular-telephone, and an I/O controller in communication with the

RF transmitter and the controller for providing communication to the land-line interface.

In one embodiment, the controller includes status ports for receiving land-line status information from the land-line interface and cellular-line status information from the cellular-telephone interface. The controller also includes control ports for providing land-line control signals to the land-line interface and cellular-line instructions to the cellular-telephone interface. In this embodiment, a processor associated with the controller determines what instructions to send in response to the status information is performed by a processor associated with the controller.

A controller can also include a tone generator connected to the land-line interface for synthesizing an audible tone and providing the audible tone to the land-line telephone in response to instructions from the processor. The tone generator can be a pulse-width modulator coupled to a filter, or it can be a pulse-code modulator. Examples of tones generated by the tone generator include dial tones, a busy signals, and a glare-warning signals.

Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention pertains. Although methods and materials similar or equivalent to those described herein can be used in the practice or testing of the present invention, suitable methods and materials are described below. All publications, patent applications, patents, and other references mentioned herein are incorporated by reference in their entirety. In case of conflict, the present specification, including definitions, will control. In addition, the materials, methods, and examples are illustrative only and not intended to be limiting.

Other features and advantages of the invention will be apparent from the following detailed description and the accompanying drawings in which:

DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a docking station connecting land-line telephones to a cellular network;

FIG. 2 shows the operation of the docking station of FIG. 1 when making an outgoing call;

FIG. 3 shows the operation of the docking station in FIG. 1 when receiving an incoming call;

FIG. 4 shows the docking station of FIG. 1 in a configuration in which land-line telephones connect to either the cellular network or a land-line network;

FIG. 5 is a circuit diagram of one of the switches in FIG. 4;

FIG. 6 shows the docking station of FIG. 1 sharing a telephone line with several other docking stations;

FIGS. 7A-7C illustrate one protocol through which the docking stations of FIG. 6 communicate with one another;

FIGS. 8A-8C illustrate another protocol through which the docking stations of FIG. 6 communicate with one another;

FIG. 9 is a block diagram of the docking station of FIG. 1;

FIG. 10 is a more detailed schematic of the docking station of FIG. 1;

FIG. 11 is a schematic diagram of the docking station of FIG. 1 but adapted to communication with an IP telephone over a LAN;

FIG. 12 is a schematic diagram of the docking station of FIG. 1 but adapted to communication with a cellular telephone across a wireless link; and

FIG. 13 is a schematic diagram of a docking station from FIG. 6.

DETAILED DESCRIPTION

FIG. 1 shows a system **10** that makes telephone service available to one or more land-line telephones **12a, 12b** connected to a first line **14a** of the premises wiring **16** of a building **18**. The system provides a docking station **20a** resembling a cellular telephone recharging cradle. Although shown in FIG. 1 as connected to the first line

14a, the docking station **20a** connects to either the first line **14a** or a second line **14b** of the premises wiring **16**. To provide telephone service to the land-line telephones **12a**, **12b**, one inserts a cellular telephone **22a** into a docking receptacle **24a** of the docking station **20a**. In the configuration shown in FIG. 1, the docking station **20a** enables land-line telephones **12a, 12b** to communicate through a cellular network **26**.

In the system shown in FIG. 1, two land-line telephones **12a, 12b** connect to the first line **14a**. However, it will be understood that other telephonic devices can be connected to the first line **14a**. For example, one can connect a fax machine or a data communication modem to the first line **14a** without altering the operation of the invention. Consequently, as used herein, the term "land-line telephone" is intended to encompass all devices adapted to communicate over a land-line network. Such devices include fax machines, speaker phones, answering machines, caller ID units, and data communication modems, and telephones that communicate over a LAN.

The premises wiring **16** illustrated in FIG. 1 is standard telephone wiring for 2500-type phones typically found in most homes and offices. Such wiring includes four conductors identified by insulating jackets in red, green, black, and yellow. By default, land-line telephones are connected to the red and green conductors. Without loss of generality, the red and green conductors will therefore be referred to collectively as "Line 1." The black and yellow conductors will be collectively referred to as "Line 2." The first line **14a** referred to above can be Line 1, in which case the second line **14b** is Line 2. Conversely, the first line **14a** can be Line 2, in which case the second line **14b** is Line 1.

FIG. 2 illustrates the operation of the docking station **20a** in the context of an outgoing call placed by a calling party using one of the land-line telephones **12a, 12b** to reach a called party. The following discussion of FIG. 2, and the discussions of all figures showing flow charts, liberally use the word "step." This is done to improve the readability of the specification and to make clear precisely what portions of the figures are referred to in their corresponding discussions. The word "step" is used only in the sense of its customary English meaning as one of a series of actions or measures taken to achieve some purpose. In particular, the word "step" is not used as a specialized talisman to invoke any presumption under 35 U.S.C. 112.

A calling party who picks up a land-line telephone, **12a, 12b** creates an off-hook condition on the first line. As shown in FIG. 2, the docking station **20a** continuously monitors the first line to determine if such an off-hook condition exists (step **28**). Upon detection of an off-hook condition (step **30**), the docking station **20a** generates a dial tone (step **32**). If the calling party hangs up the land-line telephone **12a, 12b,** the docking station **20a** detects the absence of an off-hook condition (step **34**) and reverts to its line-monitoring state (step **28**).

If the calling party dials a first sequence of digits representative of a telephone number, the docking station **20a** detects that first sequence of digits (step **36**). The docking station **20a** then awaits instructions indicating that the dialing is complete and the call should be placed. If the calling party dials a second sequence of selected digits indicating completion of the dialing process, the docking station **20a** detects this second sequence of selected digits (step **38**) and, in response, provides instructions to the cellular telephone **22a** to initiate a call to the called party as specified in the first sequence of digits (step **40**). If the called party answers, the docking station **20a** provides service to the calling party using the land-line telephone **12a, 12b** (step **42**) for as long as the calling party and the called party have their respective handsets off-hook.

The second sequence of digits is thus the equivalent of the "send" key found on most cellular telephones. The second sequence of digits can be dialed manually or automatically using a programmable speed-dial button found on many modern land-line telephones. The second sequence of digits can be as short as one digit. For example, the "#" key by itself, or the "#" key by itself, can constitute the entire second sequence of digits.

The use of a second sequence of digits, such as the "#" key, is advantageous because it eliminates the requirement of detecting the last digit dialed. Algorithms for detecting the last digit dialed tend to either count the number of digits dialed or wait for a predetermined time-out period. An algorithm that counts the number of digits dialed cannot easily be used for international calls in which the number of digits in a telephone varies. An algorithm that relies on a time-out period introduces a short, but annoying delay in the dialing process. Both these difficulties are circumvented in the present invention by enabling the docking station **20a** to implement the equivalent of a

"send" key on a conventional land-line telephone.

The docking station **20a** periodically monitors the line to detect whether one of the calling party and the called party has hung up (steps **44** and **46**). If the calling party hangs up (step **44**), the docking station **20a** sends an instruction to the cellular telephone **22a** that is equivalent to pressing the "end" key found on most cellular telephones (step **48**). If the called party hangs up (step **46**), the docking station **20a** again generates a dial tone (step **32**).

FIG. 3 shows the operation of the docking station in the context of an incoming call. As shown in FIG. 3, the docking station **20a** continuously monitors the cellular telephone **22a** for incoming calls on the cellular network **26** (step **50**).

Upon detection of an incoming call (step **52**), the docking station **20a** places a call-detected signal on the first line **14a** (step **54**). This signal manifests itself in one of three ways depending on the status of the land-line telephone **12a**. If the land-line telephone **12a** is on-hook, the call-detected signal manifests itself by causing the land-line telephone **12a** to ring. If the land-line telephone **12a** is engaged in a call, the call-detected signal manifests itself as a call-waiting signal on the ear-piece of that land-line telephone **12a, 12b**.

When a called party picks up the telephone **12a** to make an outgoing call before the telephone **12a** has had a chance to ring on an incoming call, the two parties are connected to each other without knowing it, with potentially embarrassing consequences to one or both parties. This phenomenon, referred to as "glare," is addressed by using the call-detected signal to provide one or more audible beeps in the ear-piece of the called party's land-line telephone **12a** when the land-line telephone **12a** is off-hook but has not yet finished dialing. This last state occurs when the docking station **20a** detects an incoming call (step **52**) after it has detected that a calling party has picked up the handset (step **30**) but before the docking station has placed a call (step **40**).

When the called party picks up the ringing land-line telephone **12a, 12b** to answer it, the docking station **20a** detects the resulting off-hook condition on the first line **14a** (step **56**) and establishes a connection between the cellular telephone **22a** and

the land-line telephone **12a**, **12b** (step **58**).

The docking station **20a** periodically monitors the first line **14a** to detect whether one of the calling party and the called party has hung up (steps **60** and **62**). If the called party hangs up (step **60**), the docking station **20a** sends an instruction to the cellular telephone **22a** that is equivalent to pressing the "end" key found on most cellular telephones (step **64**). If the calling party hangs up (step **62**), the docking station **20a** generates a dial tone (step **66**) while continuing to monitor the cellular telephone **22a** for incoming calls (step **50**).

When a cellular telephone **22a** receives a telephone call, it will also typically receive caller-ID information such as the caller's telephone number and name. In one aspect of the invention, the docking station **20a** requests the caller-ID information from the cellular telephone **22a** and injects that information as a burst of data between the first and second rings of the land-line telephones **12a**, **12b**. This technique simulates a caller-ID transmission as carried out on a land-line network.

The configuration shown in FIG. 1 uses a cellular telephone **22a** as an alternative to land-line telephone service. For example, the docking station **20a** shown in FIG. 1 can bring telephone service to a remote home having premises wiring **16** for telephones but lacking a land-line connection to a telephone network. The configuration shown in FIG. 1 might also be used to bring telephone service to a mobile structure, for example a yacht or cruise ship.

In many cases, however, a homeowner who subscribes to both a land-line service and cellular service may want a second telephone line. Such a homeowner may understandably be reluctant to pay yet another monthly telephone access fee for a second line. The system shown in FIG. 4 addresses the needs of such a homeowner.

In FIG. 4, the second line **14b** of the premises wiring **16** is connected by a land-line link to a land-line network **68** in the conventional manner. The first line **14a** of the premises wiring is connected to the docking station **20a** as already described in connection with FIG. 1. The embodiment shown in FIG. 4 includes switches **70a**, **70b** associated with land-line telephones **12a**, **12b** for connecting the telephones **12a**, **12b** to either the first line **14a** or the second line **14b**. In a two-line telephone, such a switch is

already built into the telephone. In the case of a single-line telephone, such switches are commercially available from a variety of manufacturers.

With a switch **70a** configured to connect its associated land-line telephone **12a** to the second line **14b**, a user who picks up the telephone **12a** and simply dials will obtain service from the land-line telephone network **68**. To place a call through the cellular network **26**, the user would have to set the switch **70a** to connect its associated telephone **12a** to the first line **14a**. Conversely, when the switch **70a** is set to connect its associated land-line telephone **12a** to the first line **14a**, a user who picks up the telephone **12a** and simply dials will obtain service through the cellular network **26**. To place a call through the land-line network **68**, such a user would have to set the switch **70a** to connect its associated telephone **12a** to the second line **14b**.

In some cases, a user who places a call on the second line **14b** may forget to reset the switch to the first line **14a** after competing the call. To avoid this difficulty, one embodiment of the switch **70a** provides for a default line. In such a switch, an automatic reset causes the switch to revert back to the default line at the end of a call.

Switches having the foregoing properties are available from a variety of manufacturers. One such switch is available from TT Systems of New York and sold under the trademark "DIRECT-A-CALL." A circuit diagram for a representative switch having these properties is provided in FIG. 5.

The docking station **20a** can generate a distinctive ring that distinguishes its calls from those arriving by way of the land-line network **68**. This enables a user to determine, on the basis of the ring, whether the call is arriving over the cellular network **26** or over the land-line network **68**.

In the case of an incoming call, a user may pick up the ringing telephone's handset without setting its associated switch **70a** to a position that corresponds to the line carrying the incoming telephone call. It is therefore preferable, in such a case, that a switch **70a** detect the line carrying the incoming call and set itself to select that line for the duration of the call.

An advantage of associating switches **70a** ,**70b** with each telephone rather than providing a single switch at the docking station **20a** is that in such a system **10**, one telephone **12a** can use the first line **14a** at the same time that a second telephone **12b** uses the second line **14b**. This is not possible in a system in which a switch is located at the docking station because both telephones would then have to use the same docking station as a switch to reach their respective lines.

As shown in FIG. 6, a plurality of docking stations **20a-d** may be connected to the first line **14a**. In the case of incoming calls, the docking station through which an incoming call arrives takes control of the first line **14a**. A user can configure each docking station **20a-d** to emit a distinctive ring. This enables a user to quickly identify the source of an incoming call.

In the context of an outgoing call, it is necessary to identify one docking station **20a** as a "primary station." A primary station **20a** is that docking station that handles outgoing calls when the user makes an outgoing call. All other docking stations **20b-d** are referred to as "secondary stations."

A docking station becomes either a primary or a secondary station on the basis of a priority assigned to that docking station by a user. In one embodiment, each docking station **20a-d** has a switch through which a user assigns it a numerical priority. In another embodiment, the docking stations **20a-d** implement instructions for converting a sequence of dialed tones into an assignment of a numerical priority.

When several docking stations **20a-d** are connected to a common line **14a** as shown in FIG. 5, it is preferable that they be able to communicate with each other. There are at least two reasons for this. First, a docking station **20a** knows only its own priority. It cannot determine, from its own priority, whether it has the highest priority of all the docking stations **20a-d**. Second, a docking station **20a** can only make an outgoing call when a cellular telephone is docked in that docking station. Hence, if a user removes the cellular telephone docked in the primary station, the remaining docking stations **20a-d** must determine among themselves which one of them is to act as the primary station in the absence of the cellular telephone normally docked in the primary station.

To coordinate line usage, the docking stations **20a-d** negotiate for line access by exchanging messages over the second line **14b** of the premises wiring **16**. This eliminates the need to provide additional wiring specifically for this task. These messages are carried by two sequential 50 ms DTMF tones separated by 50 ms. The messaging system uses the "A," "B," "C," and "D" tones to support up to sixteen different messages.

FIG. 7A shows the flow of messages that occurs when a user removes a cellular phone **22a** from a primary station **20a** (step **76**). Upon removal of its cellular telephone **22a**, the primary station **20a** broadcasts a *PRIMARY UNDOCKED* message (step **78**). In response to the receipt of the *PRIMARY UNDOCKED* message, each secondary station **20b-d** identifies itself and generates a *SECONDARY TAKES OVER* message after a delay determined by its priority (step **80**).

In one embodiment, the secondary station having the highest priority will respond last, thereby canceling responses from other secondary docking stations. In another embodiment, the secondary station having the highest priority responds first, thereby precluding other secondary docking stations from taking control of the line.

In response to the *SECONDARY TAKES OVER* message, the primary station **20a** sends a *SECONDARY TAKES OVER ACK* message. The secondary station having the highest priority then becomes an acting primary station until the cellular telephone **22a** is again docked in the primary station **20a** (step **88**).

FIG. 7B illustrates messages exchanged when a user returns the cellular telephone **22a** to the primary station **20a** (step **90**). In response to the docking of its associated cellular telephone **22a**, the primary station broadcasts a *PRIMARY DOCKED* message over the first line **14a** (step **92**). In response to the *PRIMARY DOCKED* message, the acting secondary station, designated as described in connection with FIG. 7A, cedes control of the first line **14a** back to the primary station **20a** (step **94**).

FIG. 7C shows how a secondary station **20b** borrows the first line **14a** from the primary station **20a** when a call arrives on cellular telephone **22b** docked at that secondary station **20b** (step **96**). As shown in FIG. 7C, upon receipt of a call, the

secondary station **20b** issues a *SECONDARY REQUEST LINE* message to the primary station (step **98**). The primary station then determines if the first line **14a** is in use (step **100**).

If the first line **14a** is not in use, the primary station temporarily relinquishes control of the line by issuing a *LINE AVAIL* message (step **102**). The secondary station then takes control of the line and makes the incoming telephone call available to the user (step **104**). When the secondary station no longer needs the first line, for example when the user completes the call and hangs up, the secondary station cedes control of the first line back to the primary station by sending a *SECONDARY RELEASE LINE* message (step **106**).

If the first line **14a** is in use, the primary station sends a *LINE UNAVAIL* message to the secondary station (step **108**). In this case, the secondary station ignores the call (step **110**). The *SECONDARY REQUEST LINE* message and the *LINE UNAVAIL* message are, however, available for use as call-waiting tones to be provided to the user at the primary station **20a**.

In an alternative embodiment, the docking stations broadcast their priority values to each other, as shown in FIGS. 8A-8C.

FIG. 8A shows a method for ensuring that no two docking stations have the same priority value. The method begins with the user setting a priority value of a first docking station (step **112**) in the manner already described above. The user might do so when installing a new docking station. Alternatively, the user may want to change the priority of an existing docking station. As will be apparent from the following description, there is no guarantee that the first docking station will ultimately have that priority value. For this reason, that priority value is referred to as a "proposed" priority value.

In response to the change in its priority, the first docking station broadcasts a *RING SELECT BEGIN* message to all other docking stations (step **114**). This initiates a negotiation interval during which the remaining docking stations are expected to broadcast their respective priority values. During this negotiation interval, no incoming calls are taken and no other docking station can issue a *RING SELECT BEGIN*

message.

The first docking station follows up its *RING SELECT BEGIN* message with a *PRIORITY n* message, where *n* is the proposed priority value of the first station (step **116**). The remaining docking stations compare this proposed priority value with their own priority values (step **118**). If a remaining docking station already has a priority value equal to the proposed priority value, that remaining docking station sends a *PRIORITY n ACK* message. The first docking station thus monitors the first line for the occurrence of a *PRIORITY n ACK* (step **120**).

If no *PRIORITY n ACK* message is received (step **120**), the first docking station concludes that the proposed priority value is available (step **122**). The first docking station then sends a *RING SELECT END* message to end the negotiation session and restore the system to its normal operating state (step **124**).

If a *PRIORITY n ACK* message is received from a remaining docking station, (step **120**) then the proposed priority value is unavailable (step **128**). Under these circumstances, the first docking station can notify the user (step **126**) before sending a *RING SELECT END* message to end the negotiation session and restore the system to its normal operating state (step **124**). Alternatively, the first docking station can adjust its priority number either up or down until it finds a priority value that does not cause any other docking station to transmit a *PRIORITY n ACK* message.

In one embodiment of a system having several docking stations sharing a common line, each station has a flag named *PRIMARY* which is either set to "on", in which case that station is the primary station, or set to "off," in which case that station is not the primary station. At any instant, only one station may have a *PRIMARY* flag set to "on." That station should be one having the highest priority value. To ensure that this is the case, each station periodically broadcasts a *PRIMARY n* message announcing its priority value. The responses of the remaining stations to the periodic *PRIMARY n* messages received from the any one station are shown in FIG. 8B.

The method shown in FIG. 8B begins with the transmission of a *PRIORITY n* message by a first station (step **130**). In response, a second station determines if its corresponding cellular telephone is docked (step **132**). If its corresponding cellular

telephone is not docked, it cannot receive any calls. Hence, it is not eligible to be the primary station and therefore does nothing further. If the station's corresponding cellular telephone is docked, then the second station compares its own priority with that of the first station, as broadcast on the *PRIORITY n* message (step **134**).

If the priority value of the second station is lower than that broadcast in the *PRIORITY n* message, then the second station sets its *PRIMARY* flag to "off," thereby indicating that it is not entitled to primary status (step **136**).

If the priority value of the secondary station is equal to that broadcast in the *PRIORITY n* message, then, in a policy favoring incumbency, the second station decrements its priority value (step **138**) and sets its *PRIMARY* flag to "off," thereby indicating that it is not entitled to primary status (step **140**).

Finally, if the priority value of the second station is greater than that broadcast in the *PRIORITY n* message, then that station waits a specified period, the length of which depends on that station's priority value (step **142**). If, after than specified period, the second docking station has received no *PRIORITY n* messages announcing the existence of another docking station with a higher priority, then the second docking station sets its *PRIMARY* flag to "on" (step **144**) and announces its own priority value to the other stations by broadcasting a *PRIORITY n* message (step **146**).

The method shown in FIG. 8B quickly identifies the docking station having the highest priority value. Additionally, the illustrated method is sufficiently robust to recover from process handles power outages, from the removal and reinstallation of docking stations, and from the removal and replacement of cellular telephones associated with the docking stations. The illustrated method also enables a system having multiple docking stations on a common line to be self-configuring upon installation.

Referring now to FIG. 8C, when a docking station detects an incoming call (step **148**), that docking station broadcasts a *CALL PROGRESS QUERY* to determine if the first line is already in use (step **150**). If the docking station determines that a call is in progress (step **152**), then the docking station ignores this call as described above in connection with FIG. 7C. If the docking station determines that the line is available, it

broadcasts a *CALL START* message (step **154**). The call start message causes all other stations to halt their transmissions of *PRIORITY N* messages as described in connection with FIG. 8B.

The docking station then checks to see if it is the primary station for the system (step **156**). If it is, the docking station establishes a connection between its corresponding cellular telephone and the first line. If it is not the primary station, the docking station waits for a *CALL START ACK* message from the primary station (step **160**) before it establishes a connection between its corresponding cellular telephone and the first line.

In either case, once the telephone call is completed, the docking station releases the first line by sending a *CALL COMPLETE* message (step **162**).

A wide variety of electronic configurations within the docking station can provide the features described above. FIG. 9 shows a block diagram of one such configuration. The docking station **20a** shown includes a land-line interface **164** that communicates status information concerning the land-line to a micro-controller **168.** The docking station **20a** also includes a cellular-telephone interface **166** that communicates status information concerning the cellular telephone to the micro-controller **168.** In response to this status information, the micro-controller **168** sends control signals to both the cellular-telephone interface **166** and the land-line interface **164.**

The cellular-telephone interface **166** and the land-line interface **164** have a two-way audio communication path **170** extending between each other. Among the instructions provided by the micro-controller **168** is an instruction to open this audio communication path **170** and to thereby enable a user of the land-line telephone **12a** to communicate with a user on the cellular network through the docked cellular telephone **22a.**

FIG. 10 shows one implementation of a docking station **20a** having the features described in FIG. 9. The docking station **20a** includes a micro-controller in communication with both a cellular-telephone interface **166** and a land-line interface **164.**

In the illustrated embodiment, the land-line interface **164** includes a subscriber line interface circuit **172** (SLIC) having a tip-and-ring port **174**, audio input and output ports **176a**, **176b**, a land-line control port **178**, and a land-line status port (labeled "DET" in the figure) **180**.

The tip-and-ring port **174** is connected, through some intervening filters, to a line-selector switch **182**. This line-selector switch **182** enables the land-line interface **164** to connect to either the first line **14a** or to the second line **14b** of the premises wiring **16**. Note that this switch is not the same as the switches **70a**, **70b** associated with each of the telephones **12a**, **12b** connected to the premises wiring **16**.

The land-line control port **178** and the land-line status port **180** are both connected to the micro-controller **168**. Through the land-line status port **180**, the SLIC **172** provides status information concerning the premises wiring **16** to the micro-controller **168**. Such status information includes whether a land-line telephone **12a** connected to the premises wiring **16** is off-hook or not. Through the land-line control port **178**, the SLIC **172** receives instructions from the micro-controller **168**. Such instructions include to instructions to generate a ringing voltage on the tip-and-ring port **174**, thereby causing land-line telephones **12a**, **12b** connected to the premises wiring **16** to ring. Such instructions also include instructions to connect the audio input and output ports **176a**, **176b** to the tip-and-ring port **174**.

The illustrated cellular telephone **166** interface includes speaker and microphone ports **184a**, **184b** that are conventionally used to interface with car-kit microphones and speakers. As a result, use of these ports typically disables the cellular telephone's own microphone and speaker. By connecting the speaker and microphone ports **184a**, **184b** of the cellular-telephone interface **166** with the audio input and output ports **176a**, **176b** respectively, one establishes a two-way voice communication path between the cellular telephone **22a** and the SLIC **172**. In response to an instruction from the micro-controller **168**, the SLIC **172** can connect this voice communication path **170** to the premises wiring **16** by way of its tip-and-ring port **174**, thereby completing a two-way voice communication path between the cellular telephone **22a** and land-line telephones **12a**, **12b** connected to the premises wiring **16**.

The cellular-telephone interface **166** includes a cellular-telephone-status port **186** that provides status information on the cellular telephone **22a**. This status information includes information on whether the cellular telephone **22a** is docked and ready to for use, information on whether there is an incoming call on the cellular telephone **22a**, information indicating the source of that call, and information indicating whether or not the cellular telephone is engaged in a call or otherwise unavailable for use. Status information concerning the status of the cellular telephone is made available to the micro-controller **168** through its UART (Universal Asynchronous Receive/Transmit) RD port **188**. The presence or absence of a cellular telephone **22a** in the docking station **20a** is apparent from a change in the base voltage level of the signal at the cellular-telephone-status port **186**. This change is detected by the micro-controller **168** through a docked-detector port **200**.

The cellular-telephone interface **166** also includes a cellular-telephone-control port **190** for receiving commands sent from the micro-controller **168**. These commands, which the micro-controller **168** sends through its UART TD port **192**, can include instructions to place a call to the location specified by the first sub-sequence of digits dialed by a caller, to initiate the call in response to the second sub-sequence of digits dialed by the caller, and to end the call in response to an on-hook condition on the telephone line connected to the tip-and-ring port **174**.

In the illustrated embodiment, the cellular-telephone-status port **186** is the TD Fbus port on the cellular-telephone interface **166**. For some cellular telephones, however, the cellular-telephone-status port **186** is the MBus port **195** on the cellular-telephone interface **166**. Similarly, for the illustrated embodiment, the cellular-telephone-control port **190** is the RD Fbus port on the cellular-telephone interface **166**. For some cellular telephones, the cellular-telephone-control port **190** is the MBus port **195** on the cellular-telephone interface **166**.

To accommodate this, the micro-controller **168** includes an Mbus-selection port **194** on which it places a bus-selection signal for selecting whether the UART ports **188, 192** of the micro-controller **168** will communicate to the cellular-telephone interface **166** through the pair of FBus ports **186, 190** or through an Mbus port **195**. A high bus-selection signal on the Mbus-selection port **194** disables first and second

buffers **196, 198** on the two FBus lines so as to block traffic between the Fbus ports **186, 190** and the UART ports **188, 192**. At the same time, the high bus-selection signal enables third and fourth buffers **200, 202** that enable traffic to flow between the MBus port **195** and the UART ports **188, 192**. Conversely, a low bus-selection signal enables the first and second buffers **196, 198** and disables the third and fourth buffers **200, 202,** thereby blocking traffic between the UART ports **188, 192** and the MBus port **195** and allowing traffic between the FBus ports **186, 190** and the UART ports **188, 192.**

The illustrated docking station also includes tone-generating elements for generating the various audio tones used to communicate status information regarding the cellular telephone **22a** to someone attempting to place a call over the cellular network **26** using a land-line telephone **12a** connected to the premises wiring **16**. Such tones include dial tones, busy signals, and signals indicating the existence of a glare condition. In an alternative embodiment, shown in FIG. 6, tones generated by the tone-generating elements can be used to communicate with other docking stations **22b-d** connected to the same line.

The tone generating elements include a PWM (pulse width modulator) port **204** on the micro-controller **168** that provides a sequence of pulses. The pulse sequence from the PWM port **204** is passed to a filter **206** that alters its spectrum to generate the desired tone. The desired tone is then provided to the audio input port **176a** of the SLIC **172**, which then passes it to the land-line telephone **12a** through the tip-and-ring port **174** of the SLIC **172**.

The tones generated by the tone generating elements can be selected to simulate those generate by the land-line network **68**. Alternatively, it may be desirable to provide tones that are distinct from those provided by the land-line network **68** so that a caller can easily tell whether the land-line telephone **12a** is connected to the land-line network or to the cellular network **26**. The ability to alter the dial tones and ringing tones is also desirable for simulating tones in other countries that do not necessarily use tones identical to those used domestically.

The docking station **20a** also includes a DTMF decoder **208** connected between the audio-output port **176b** of the SLIC **172** and the micro-controller **168**. The DTMF decoder **208** enables a caller to use the keypad of a land-line telephone **12a** to send

instructions to the micro-controller **168** by using sequences of tones. These sequences of tones may represent telephone numbers to be dialed on the cellular telephone **22a**, a send command to be transmitted to the cellular telephone **22a**, or instructions for configuring the docking station **20a**. When appropriate, the micro-controller **168** incorporates instructions representing these tone sequences into the instructions that it provides to the cellular-telephone interface **166**.

The micro-controller **168** selects control signals on the basis of status signals from both the SLIC **172** and the cellular-telephone interface **166**. It does so by executing programmed instructions stored in the micro-controller **168**. These instructions implement the features described in connection with the discussion of FIGS. 2 and 3. The use of a programmable micro-controller **168** enables one to easily modify the operation of the docking station without the need to modify hardware.

The cellular-telephone interface **166** shown in FIG. 9 is that associated with a cellular telephone sold under the trademark NOKIA. The details on the ports of the cellular-telephone interface **166** and the manner in which they interface with the micro-controller **168** are thus specific to this particular cellular telephone. These details can be expected to vary depending on the specific type of cellular telephone. What is important is that there be a connection between the micro-controller **168** and the cellular-telephone interface **166** that enables the micro-controller **168** to detect the status of the cellular telephone **22a** and that enables the micro-controller **168** to provide instructions to the cellular telephone **22a**.

In another embodiment, the land-line telephone **12a** is a telephone connected to a local area network. A docking station **20a** for interfacing with such a telephone includes a LAN controller **210** as shown in FIG. 11. In the embodiment shown in FIG. 11, a telephone connects to a 10/100 Base T port **212** on the LAN controller **210** through an RJ-45 port **214**. The LAN controller **210** connects to the tip-and-ring port **174** of the SLIC **172** through an HPNA port **216** on the LAN controller **210**. The HPNA port **216** provides signals that appear to the SLIC **172** to be coming from conventional premises wiring. In this embodiment, the SLIC **172** is unable to detect an off-hook condition on the line. Consequently, the micro-controller **168** obtains this information directly from the LAN controller **210**. With the foregoing exceptions, the

remaining components of the docking station **20a** operate in the same manner as already described in connection with FIG. 10.

A cellular telephone **22a** typically has electrical contacts through which it communicates with the cellular-telephone interface **166**. This communication occurs upon docking the cellular telephone **22a** in the docking station **20a** so that corresponding electrical contacts in the docking receptacle **24** are in electrical communication with the electrical contacts on the cellular telephone **22a.**

The word "docking" is not, however, restricted to the case in which a cellular telephone **22a** is nestled in a receptacle **24a** in the housing of a docking station **20a.** Instead, a cellular telephone **22a** is "docked" in the docking station **20a** when the docking station **20a** is able to establish communication with the cellular telephone **22a.** In particular, the docking station **20a** and the cellular telephone **22a** can engage in short-range wireless communication using a protocol known by the trade name BLUETOOTH. Such a docking station **20a** can detect the presence of a nearby cellular telephone **22a** and thereafter send and receive signals through antennas built into the cellular telephone **22a** and the docking station **20a.**

A docking station adapted to connect to a cellular telephone **22a** in this manner is shown in FIG. 12. The illustrated docking station includes an RF controller **220** connected to an antenna **222.** The RF controller **220** communicates with an I/O controller **224** having an audio port **226** for passing audio signals to and retrieving audio signals from the cellular telephone **22a.** These audio signals are provided to the SLIC **172** by way of the micro-controller **168** rather than by using the audio ports of the SLIC **172** as was the case in the embodiments shown in FIGS. 10 and 11.

As another alternative to physical coupling of a cellular telephone **22a** to the docking station **20a,** a desktop charging cradle is used to hold and charge the cellular telephone **22a** can include a connector for operably coupling with a docking station **20a.**

The docking station **20a** provide a variety of convenience features. For example, the docking station **20a** can feature its own RJ-11 jack so that use of the docking station **20a** does not eliminate a telephone outlet from a home. The docking

station **20a** can also include a power supply and regulator that can recharge a docked cellular telephone **22a**.

The docking station also provides user-configuration controls. These controls enable the user to select the type of ring generated by the SLIC **172** when the docking station receives an incoming cellular call, to designate a priority value for the docking station, and to select which line on the premises wiring connects to the tip-and-ring port of the SLIC **172**. The user-configuration controls can be hardware, such as switches or sliders. Or, the user-configuration controls can be software switches implemented by the micro-controller **168** in response to instructions provided by the user through a suitable input medium, for example through DTMF tones generated by a telephone.

The docking station also features status indicators, such as light emitting diodes (LEDs), that indicate that the docking station has power, and if so, whether a cellular telephone **22a** is docked in the docking station and connected to its cellular network and whether the docking station is in-use.

Since different cellular telephones have different shapes and different arrangements of interface ports, the housing of the docking station can be tailored to conform to the shapes of different cellular telephones. Alternatively, a docking station manufacturer can provide individual adapters that couple different cellular telephones to a generic housing.

As noted above in connection with the discussion of FIG. 6, it is preferable that docking stations be able to communicate with one another so as to assure that only one docking station, namely the one with the highest priority, will place outgoing calls on the common telephone-line. In order to communicate with each other, each docking station must be able to send messages on the telephone-line, even if that docking station is not the primary station. Although the docking stations can, in principle, pass messages to each other through the tip-and-ring terminals of their respective SLICs, this is an undesirable method of achieving such access because the presence of more than one active SLIC on a telephone-line leads to unreliable behavior.

FIG. 13 shows an embodiment of a docking station **20a** that can send and receive DTMF tones on the telephone-line without using the SLIC. In this embodiment,

messages for other docking stations **20b-d** are generated at the PWM port **204** and injected directly into the telephone-line. Similarly, DTMF tones received from other docking stations **20b-d** are received through a direct connection between the DTMF decoder **208** and the telephone-line.

Having described the invention, and a preferred embodiment thereof, what we claim as new and secured by letters patent is:

CLAIMS

1. An interface for coupling a cellular network to a land-line telephone connected to premises wiring, the interface comprising:

   an off-hook detector for connection to said premises wiring for detecting an off-hook condition at said land-line telephone;

   a dial-tone generator for connection to said premises wiring, said dial-tone generator providing a dial tone to said land-line telephone in response to said off-hook condition;

   a processing system for connection to said premises wiring and to a cellular telephone having access to said cellular network, said processing system

      generating dialing instructions for execution by said cellular telephone in response to a sequence of tones generated by said land-line telephone,

      said sequence of tones including a first sub-sequence indicative of a telephone number and a second sub-sequence for instructing said cellular telephone to send instructions representative of said first sub-sequence to said cellular network.

2. The interface of claim 1 further comprising a glare detector for connection to said cellular telephone, said glare detector generating a first signal indicative of a connection across said cellular network between said cellular telephone and a calling party.

3. The interface of claim 2 wherein said glare detector is in communication with said processing system and said processing system is configured to provide a glare-warning signal to said land-line telephone in response to detection of said first signal from said call detector.

4. The interface of claim 1 further comprising a wireless interface for connecting said processing system to said cellular telephone.

5. The interface of claim 4 wherein said cellular-telephone interface is a wireless interface.

6. The interface of claim 1 wherein said premises wiring includes at least a first line and a second line independent of said first line, and said interface further includes a switch associated with said land-line telephone for connecting said land-line telephone to said first line.

7. The interface of claim 1 further comprising a suppression system coupled to said dial-tone generator for determining a relative priority of said interface and suppressing operation of said dial-tone generator on the basis of said relative priority.

8. The interface of claim 7 wherein said interface has an absolute priority and said suppression system includes a priority-broadcaster for placing a signal indicative of said absolute priority on said premises wiring.

9. The interface of claim 7 wherein said suppression system includes a priority-receiver for detecting a signal indicative of an absolute priority of a second interface in communication with said premises wiring.

10. The interface of claim 1 wherein said premises wiring is a local area network and said interface further comprises a network interface in communication with said processing system.

11. A system for coupling a cellular network to a land-line telephone connected to premises wiring having a first circuit and a second circuit, said system comprising:

a switch associated with said land-line telephone for connecting said land-line telephone to said first circuit;

an interface for coupling said cellular network to said first circuit, said interface including

an off-hook detector for connection to said premises wiring for detecting an off-hook condition at said land-line telephone;

a dial-tone generator for connection to said premises wiring, said dial-tone generator providing a dial tone to said land-line telephone in response to said off-hook condition;

a processing system for connection to said premises wiring and to a cellular telephone having access to said cellular network, said processing system generating dialing instructions for execution by said cellular telephone in response to a sequence of tones generated by said land-line telephone.

12. A system for providing cellular network access to a land-line telephone connected to premises wiring having a first telephone-line and a second telephone-line, said system comprising:

a land-line interface for connection to at most said first telephone-line of said premises wiring;

a cellular-telephone interface for connection to a cellular telephone having access to said cellular network; and

a controller in communication with said land-line interface and said cellular-telephone interface, said controller establishing an audio connection between said cellular-telephone interface and said land-line interface in response to status information provided to said controller by said cellular interface and said land-line interface.

13. The system of claim **12**, wherein said controller comprises

an input port for receiving a sequence of tones from said land-line interface, said sequence of tones including

a first sub-sequence indicative of a telephone number, and

a second sub-sequence for instructing said cellular telephone to send instructions representative of said first sub-sequence to said cellular network; and

a control signal output for providing dialing instructions for execution by said cellular telephone in response to said sequence of tones.

14. The system of claim 12 further comprising a switch having a first setting for selecting said first telephone-line and connecting said land-line telephone to said land-line interface, and a second setting for selecting said second telephone-line and disconnecting said land-line telephone from said land-line interface.

15. The system of claim 12, wherein said land-line interface comprises a subscriber-line interface circuit.

16. The system of claim 15, wherein said subscriber-line interface circuit comprises input and output analog audio ports for connection to corresponding output and input analog audio ports on said cellular-telephone interface.

17. The system of claim 16 wherein said controller comprises an output analog audio port connected to said input analog audio port of said subscriber-line interface circuit for injecting a tone therein.

18. The system of claim 16 wherein said controller comprises an input analog audio port connected to said output analog audio port of said subscriber-line interface circuit for receiving a tone therefrom.

19. The system of claim 12 wherein said land-line interface comprises a network interface to a local-area network with which said land-line telephone is in data communication.

20. The system of claim 12 wherein said cellular-telephone interface includes a receptacle adapted to secure said cellular-telephone to an electrical contact disposed in said receptacle, said electrical contact providing communication between said cellular-telephone and said cellular-telephone interface.

21. The system of claim 12 wherein said cellular-telephone interface comprises

an antenna;

an RF transmitter coupled to said antenna for providing a signal to said antenna for reception by said cellular-telephone; and

an I/O controller in communication with said RF transmitter and said controller for providing communication to said land-line interface.

22. The system of claim **12** wherein said controller comprises:

a land-line status port for receiving land-line status information from said land-line interface;

a cellular-line status port for receiving cellular-line status information from said cellular-telephone interface;

a land-line control port for providing land-line control signals to said land-line interface;

a cellular-line control port for providing cellular-line instructions to said cellular-telephone interface; and

a processor for selecting said cellular-line instructions and said land-line instructions in response to said land-line status information and said cellular-line status information.

23. The system of claim **22** wherein said controller comprises a tone generator connected to said land-line interface for synthesizing an audible tone and providing said audible tone to said land-line telephone in response to instructions from said processor.

24. The system of claim **23** wherein said tone generator comprises a pulse-width modulator coupled to a filter.

25. The system of claim **23** wherein said tone generator comprises a frequency-shift modulator.

26. The system of claim **23** wherein said audible tone is selected from the group consisting of a dial tone, a busy signal, a glare-warning signal, and a DTMF

tone.

27. The system of claim **22** further comprising a DTMF decoder connected between said land-line interface and said controller for decoding a tone provided by said land-line interface.

28. The system of claim **22** further comprising

a DTMF decoder connected between said first telephone-line and said controller for decoding a tone present on said first telephone-line and

a tone generator connected to said first telephone-line for synthesizing an audible tone and placing said audible tone on said first telephone-line in response to instructions from said processor.

29. A method for providing cellular network access to a land-line telephone connected to premises wiring having a first telephone-line and a second telephone-line, said method comprising:

providing a land-line interface for connection to at most said first telephone-line of said premises wiring;

providing a cellular-telephone interface for connecting to a cellular telephone having access to said cellular network; and

establishing an audio connection between said cellular-telephone interface and said land-line interface in response to status information provided by said cellular interface and said land-line interface.

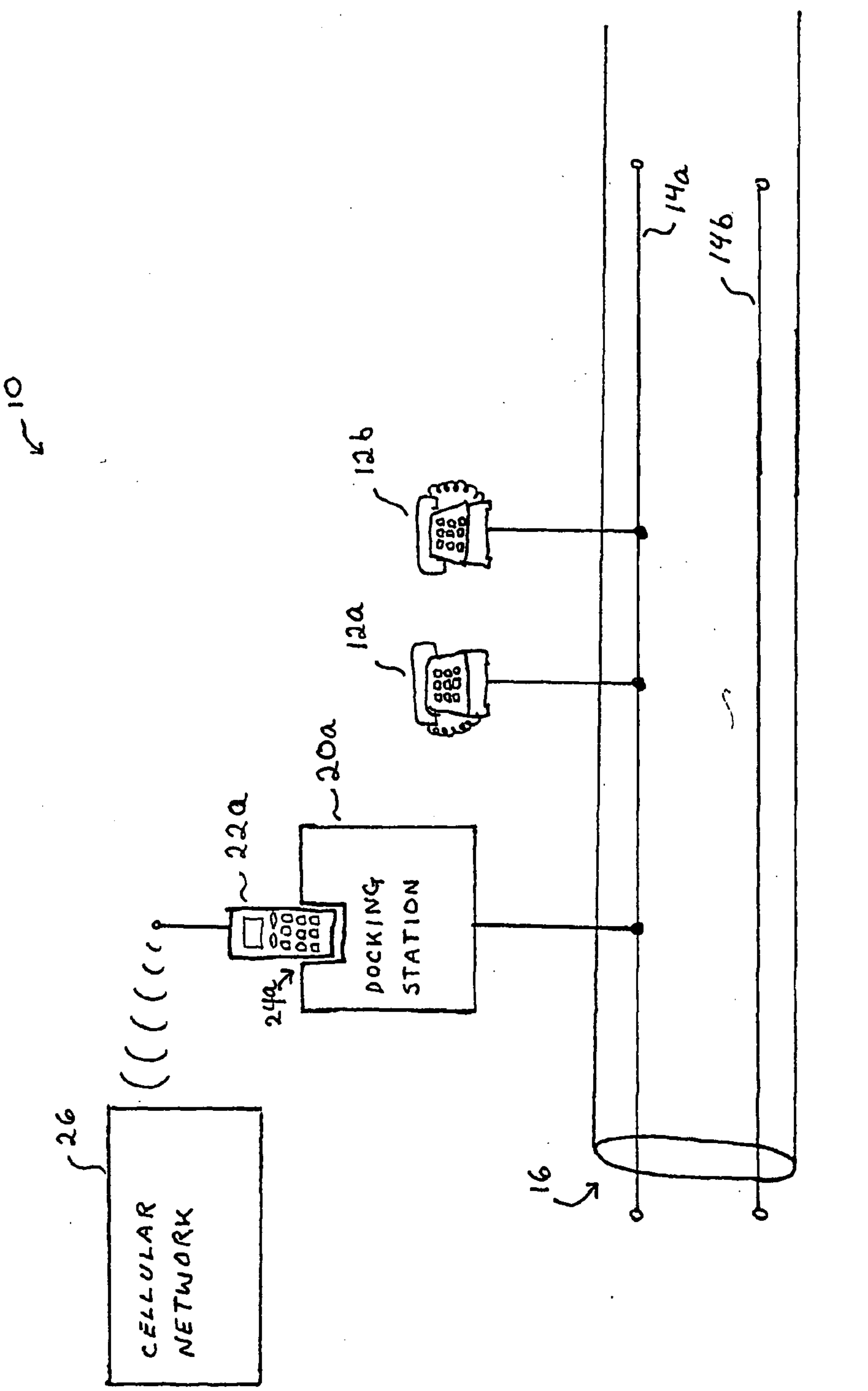

10
CELLULAR NETWORK
26
DOCKING STATION
20a
22a
24a
12a
12b
14a
14b
16

FIG. 1

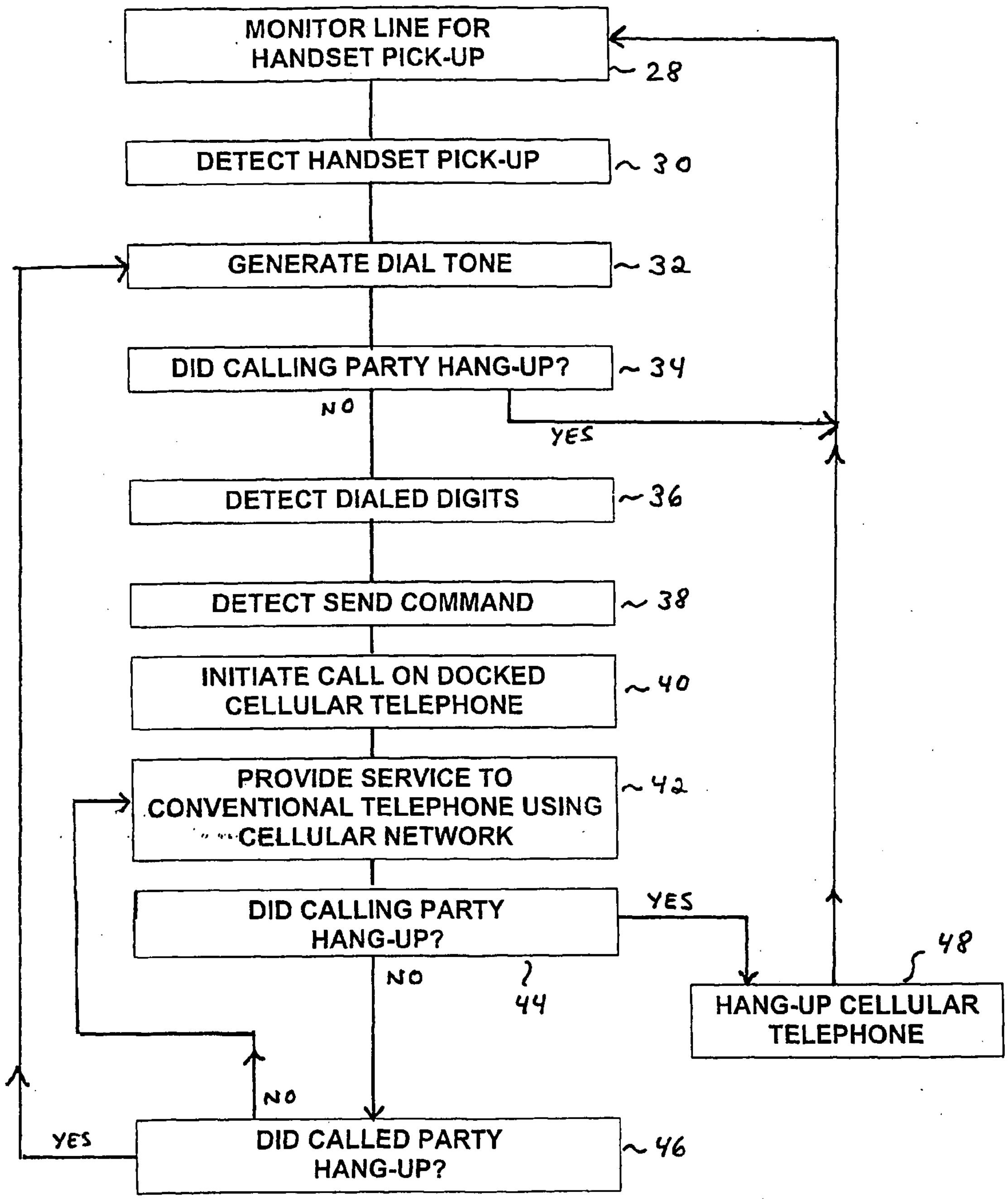

MONITOR LINE FOR HANDSET PICK-UP
28
DETECT HANDSET PICK-UP
30
GENERATE DIAL TONE
32
DID CALLING PARTY HANG-UP?
34
NO
YES
DETECT DIALED DIGITS
36
DETECT SEND COMMAND
38
INITIATE CALL ON DOCKED CELLULAR TELEPHONE
40
PROVIDE SERVICE TO CONVENTIONAL TELEPHONE USING CELLULAR NETWORK
42
DID CALLING PARTY HANG-UP?
YES
NO
44
48
HANG-UP CELLULAR TELEPHONE
NO
YES
DID CALLED PARTY HANG-UP?
46

FIG. 2

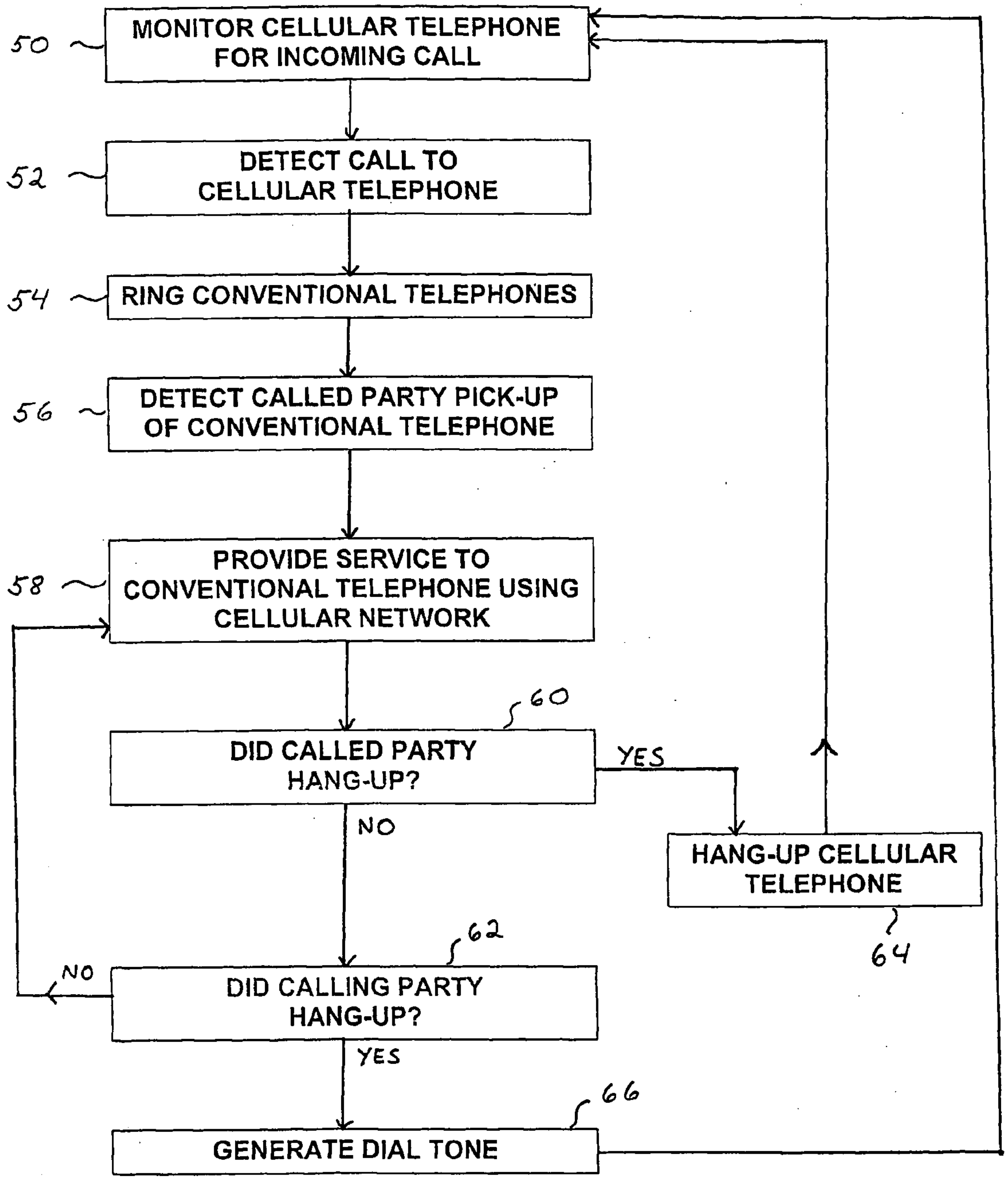

MONITOR CELLULAR TELEPHONE FOR INCOMING CALL
50
DETECT CALL TO CELLULAR TELEPHONE
52
RING CONVENTIONAL TELEPHONES
54
DETECT CALLED PARTY PICK-UP OF CONVENTIONAL TELEPHONE
56
PROVIDE SERVICE TO CONVENTIONAL TELEPHONE USING CELLULAR NETWORK
58
DID CALLED PARTY HANG-UP?
60
YES
NO
HANG-UP CELLULAR TELEPHONE
64
DID CALLING PARTY HANG-UP?
62
NO
YES
GENERATE DIAL TONE
66

FIG. 3

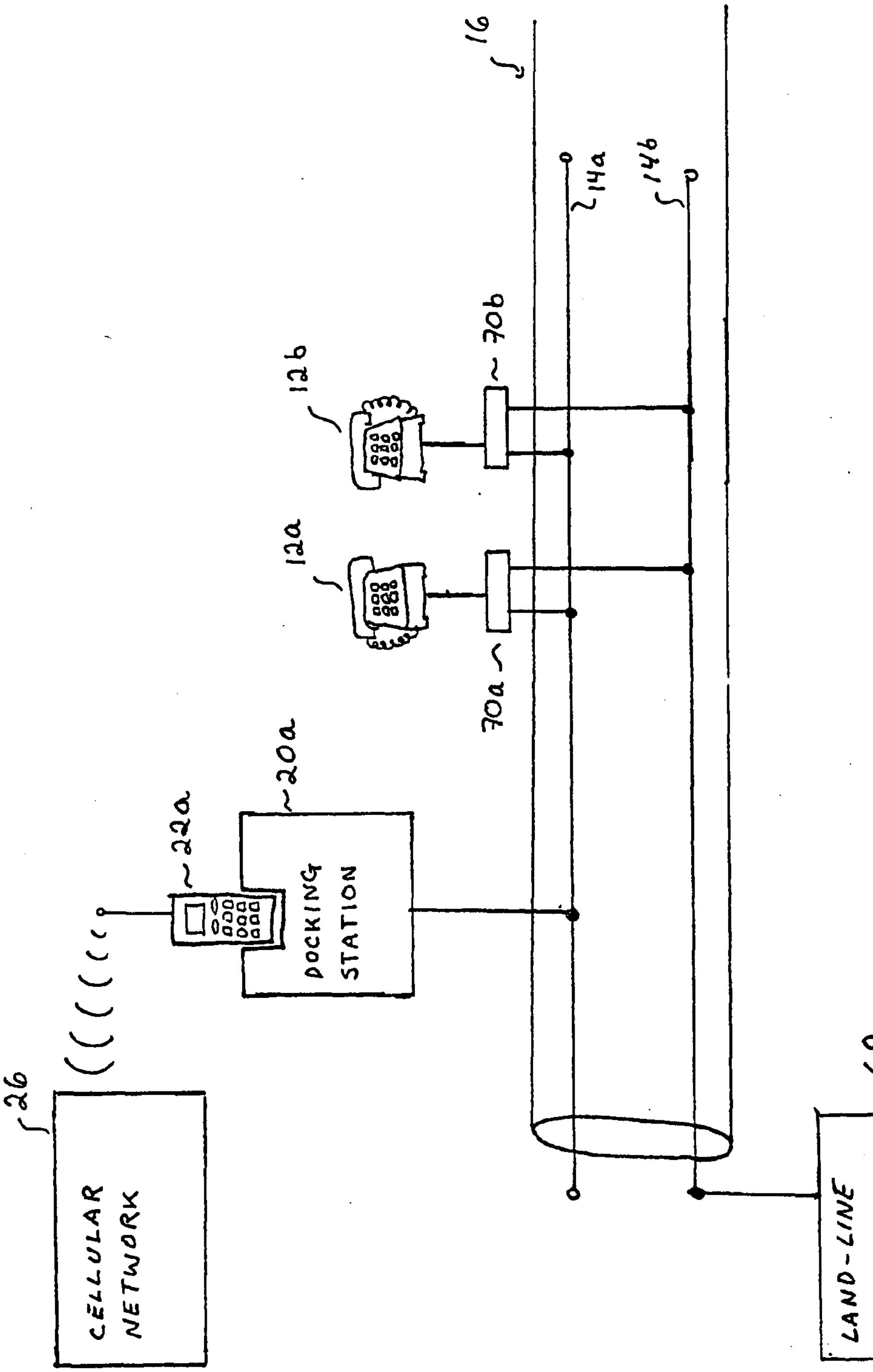

CELLULAR NETWORK
26
22a
DOCKING STATION
20a
12a
12b
70a
70b
16
14a
14b
LAND-LINE NETWORK
68

FIG. 4

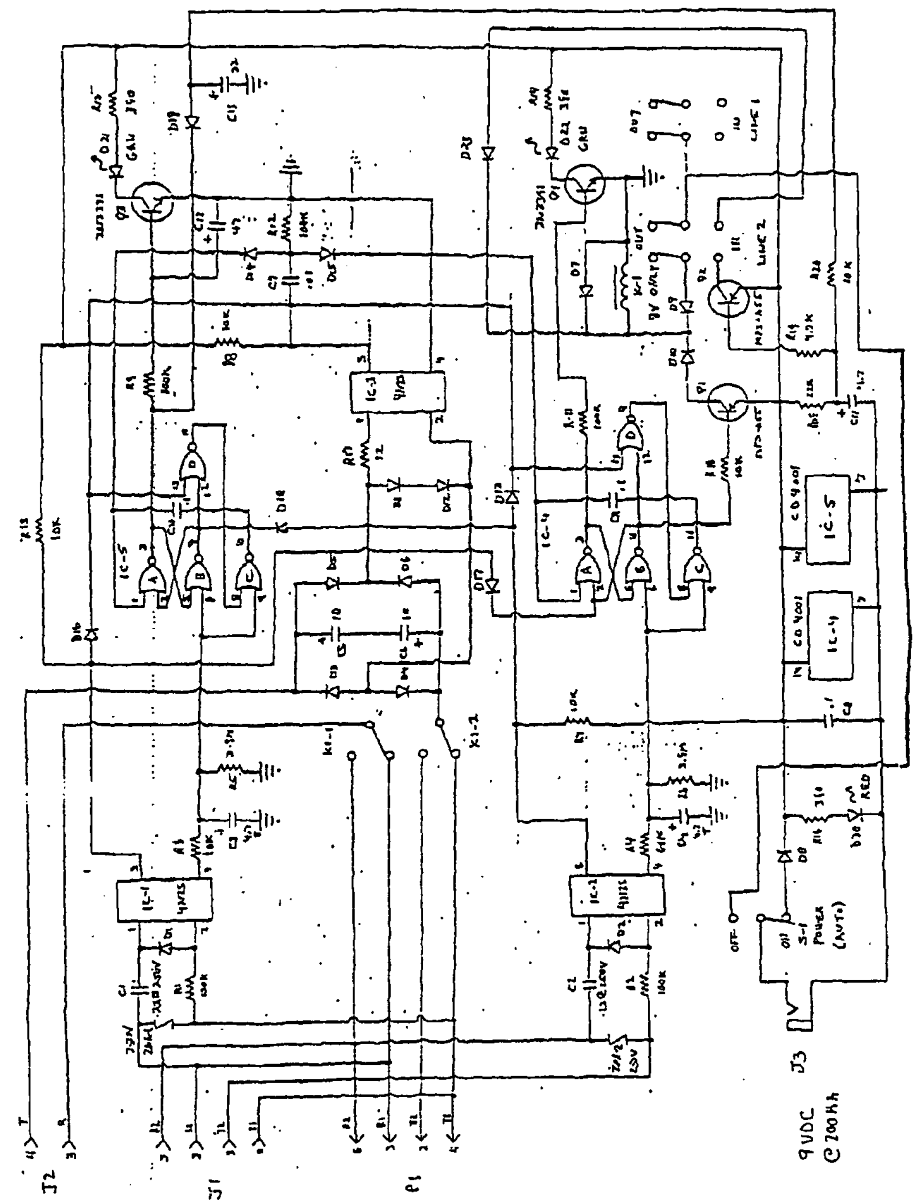
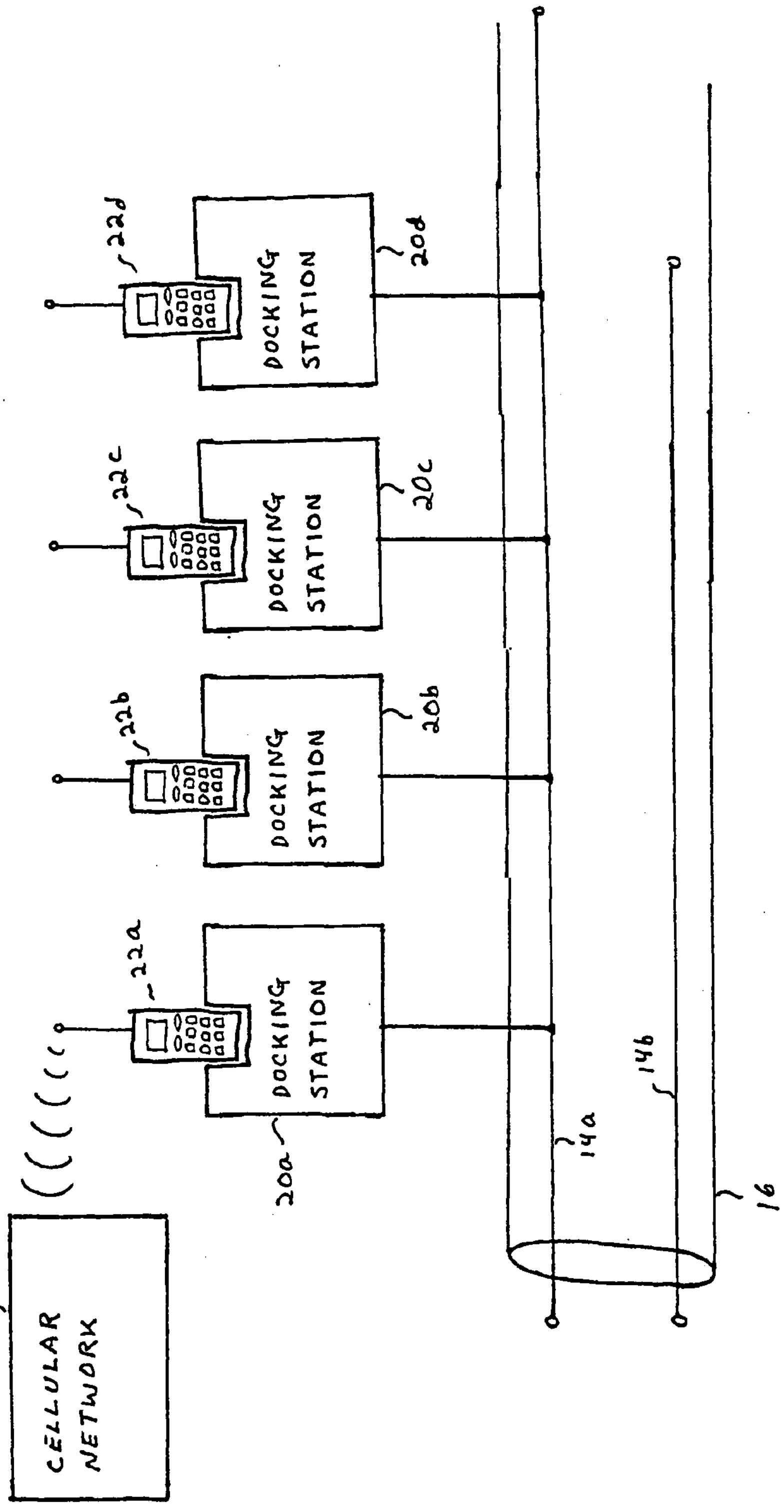


FIG. 5



26
CELLULAR NETWORK
22a
22b
22c
22d
DOCKING STATION
DOCKING STATION
DOCKING STATION
DOCKING STATION
20a
20b
20c
20d
14a
14b
16

FIG. 6

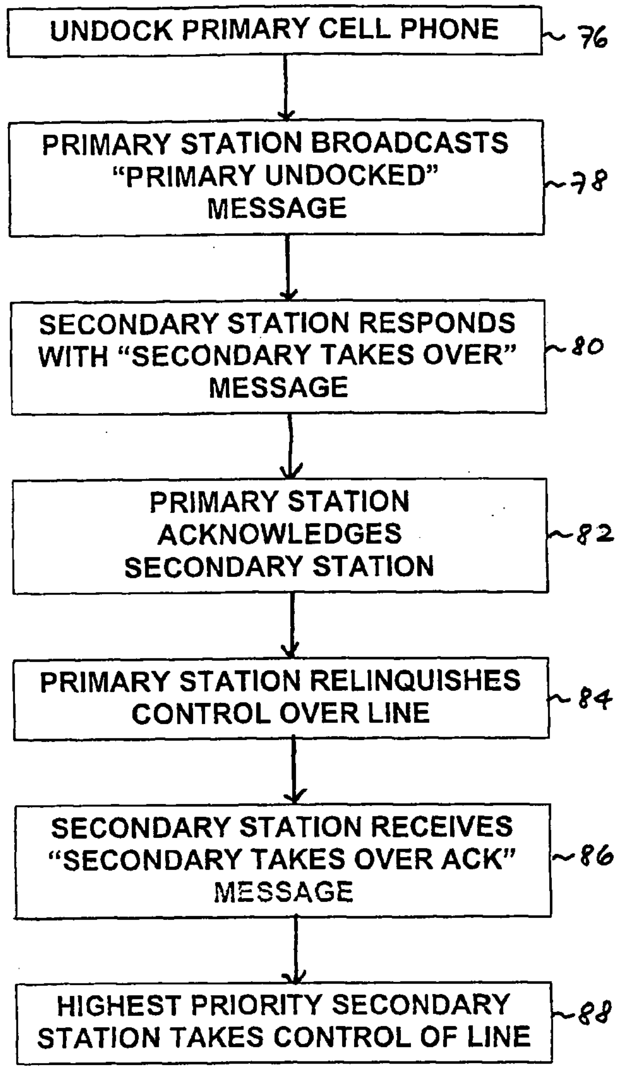

UNDOCK PRIMARY CELL PHONE
76
PRIMARY STATION BROADCASTS "PRIMARY UNDOCKED" MESSAGE
78
SECONDARY STATION RESPONDS WITH "SECONDARY TAKES OVER" MESSAGE
80
PRIMARY STATION ACKNOWLEDGES SECONDARY STATION
82
PRIMARY STATION RELINQUISHES CONTROL OVER LINE
84
SECONDARY STATION RECEIVES "SECONDARY TAKES OVER ACK" MESSAGE
86
HIGHEST PRIORITY SECONDARY STATION TAKES CONTROL OF LINE
88

FIG. 7A

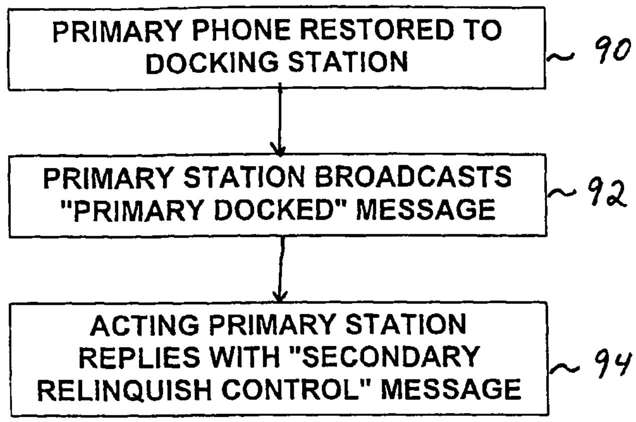

PRIMARY PHONE RESTORED TO DOCKING STATION
90
PRIMARY STATION BROADCASTS "PRIMARY DOCKED" MESSAGE
92
ACTING PRIMARY STATION REPLIES WITH "SECONDARY RELINQUISH CONTROL" MESSAGE
94

FIG. 7B

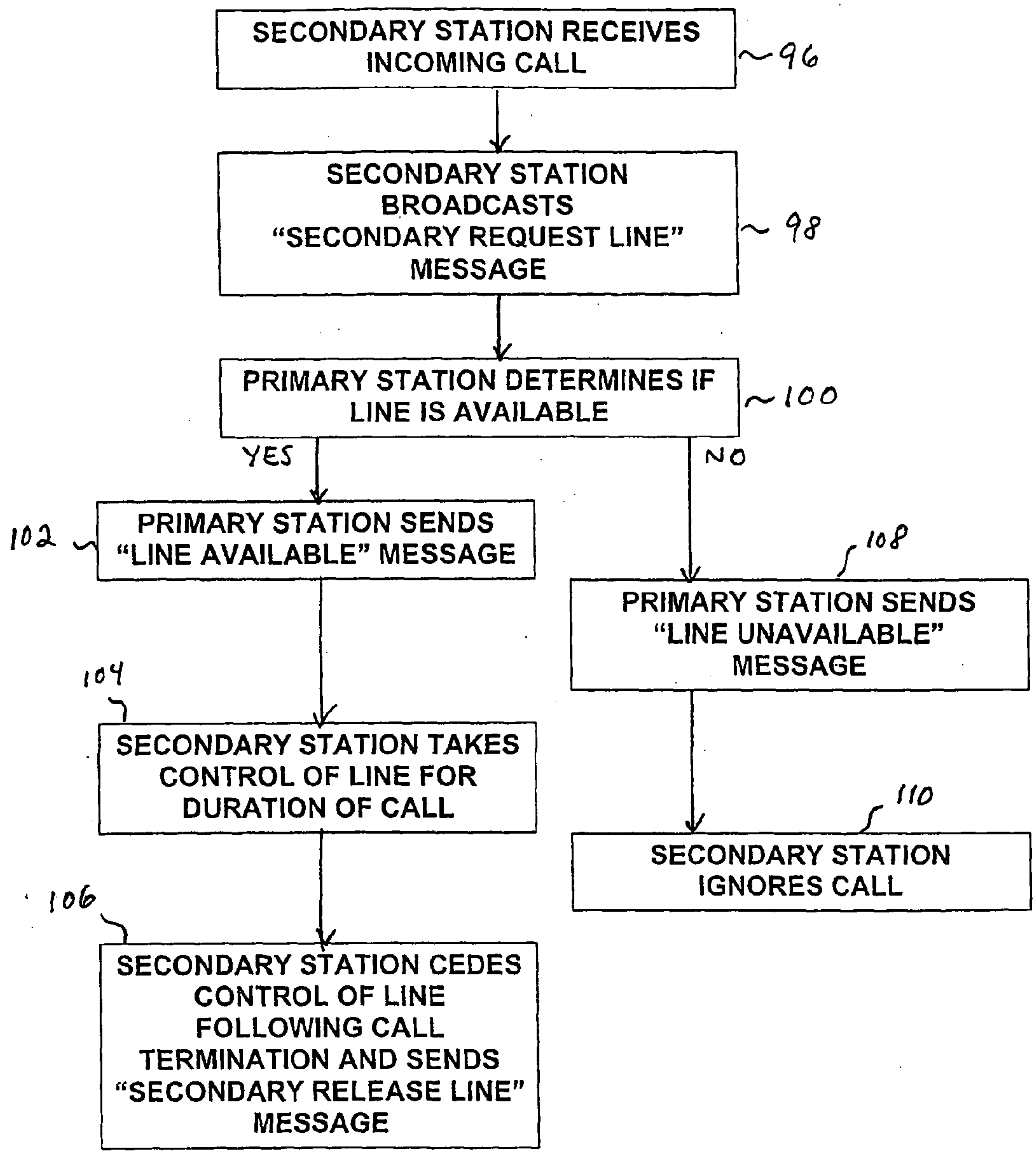

SECONDARY STATION RECEIVES INCOMING CALL
96
SECONDARY STATION BROADCASTS "SECONDARY REQUEST LINE" MESSAGE
98
PRIMARY STATION DETERMINES IF LINE IS AVAILABLE
100
YES
NO
102
PRIMARY STATION SENDS "LINE AVAILABLE" MESSAGE
108
PRIMARY STATION SENDS "LINE UNAVAILABLE" MESSAGE
104
SECONDARY STATION TAKES CONTROL OF LINE FOR DURATION OF CALL
110
SECONDARY STATION IGNORES CALL
106
SECONDARY STATION CEDES CONTROL OF LINE FOLLOWING CALL TERMINATION AND SENDS "SECONDARY RELEASE LINE" MESSAGE

FIG. 7C

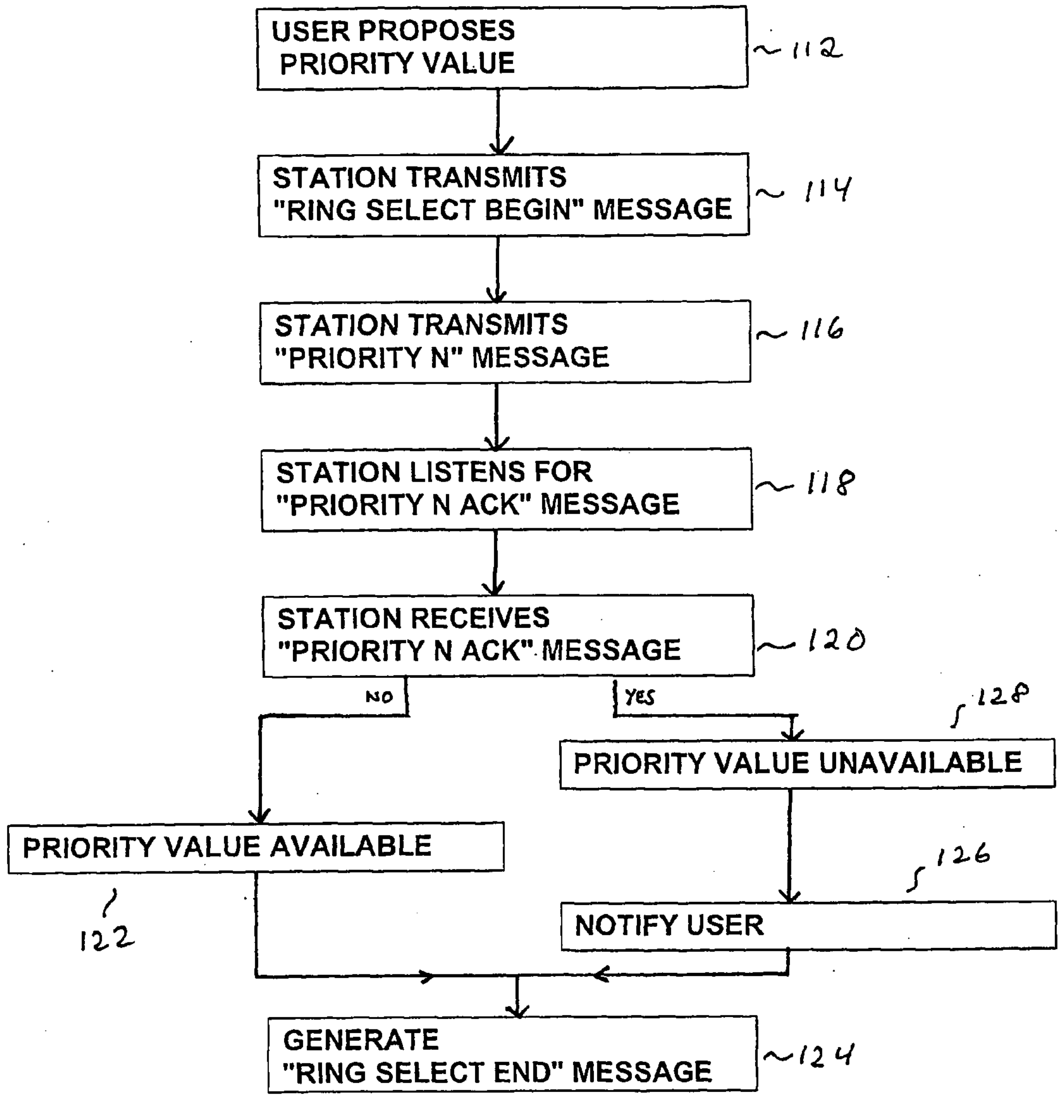

USER PROPOSES PRIORITY VALUE
112
STATION TRANSMITS "RING SELECT BEGIN" MESSAGE
114
STATION TRANSMITS "PRIORITY N" MESSAGE
116
STATION LISTENS FOR "PRIORITY N ACK" MESSAGE
118
STATION RECEIVES "PRIORITY N ACK" MESSAGE
120
NO
YES
128
PRIORITY VALUE UNAVAILABLE
PRIORITY VALUE AVAILABLE
122
126
NOTIFY USER
GENERATE "RING SELECT END" MESSAGE
124

FIG. 8A

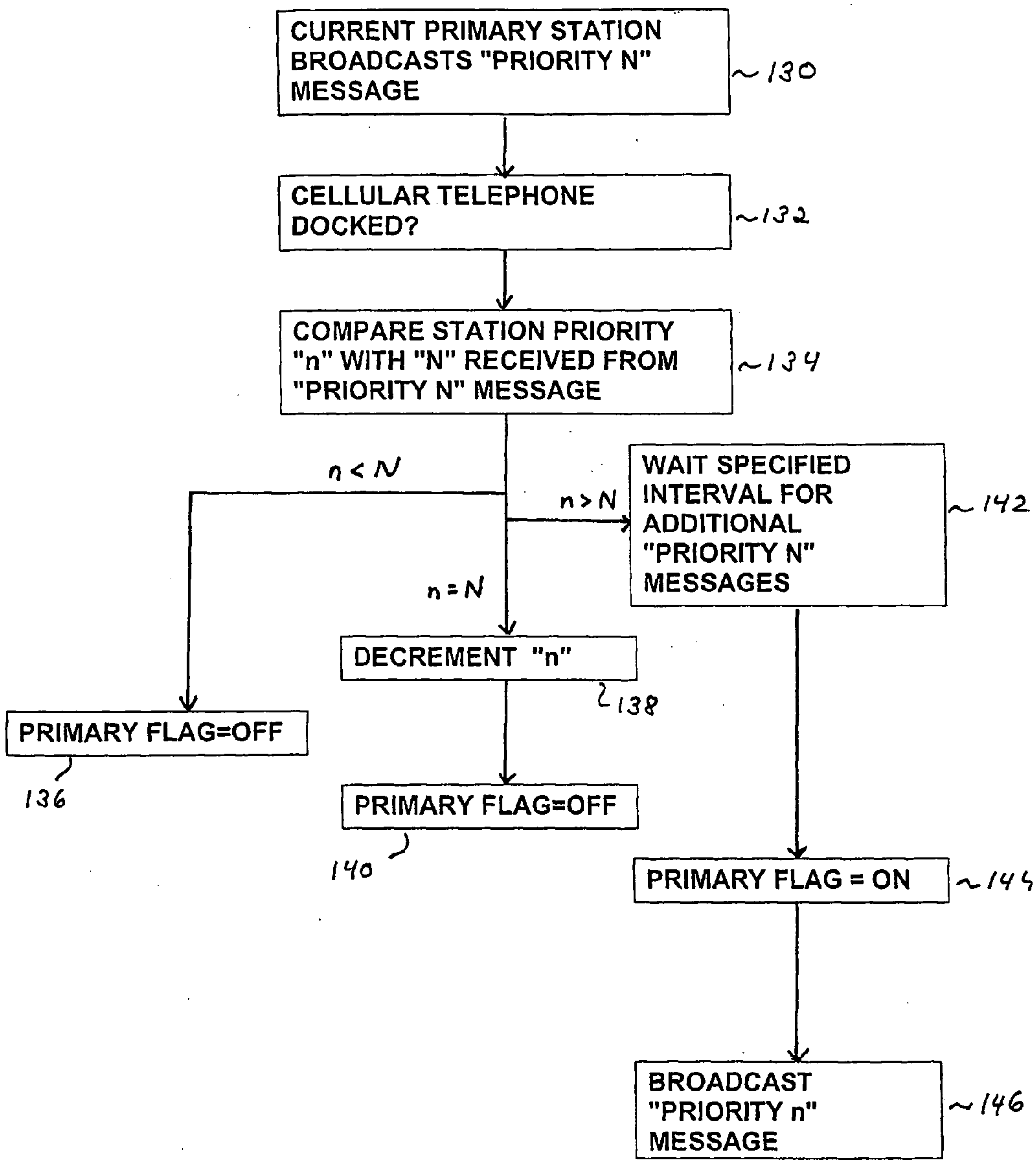

CURRENT PRIMARY STATION BROADCASTS "PRIORITY N" MESSAGE
130
CELLULAR TELEPHONE DOCKED?
132
COMPARE STATION PRIORITY "n" WITH "N" RECEIVED FROM "PRIORITY N" MESSAGE
134
n < N
n > N
n = N
WAIT SPECIFIED INTERVAL FOR ADDITIONAL "PRIORITY N" MESSAGES
142
DECREMENT "n"
138
PRIMARY FLAG=OFF
136
PRIMARY FLAG=OFF
140
PRIMARY FLAG = ON
144
BROADCAST "PRIORITY n" MESSAGE
146

FIG. 8B

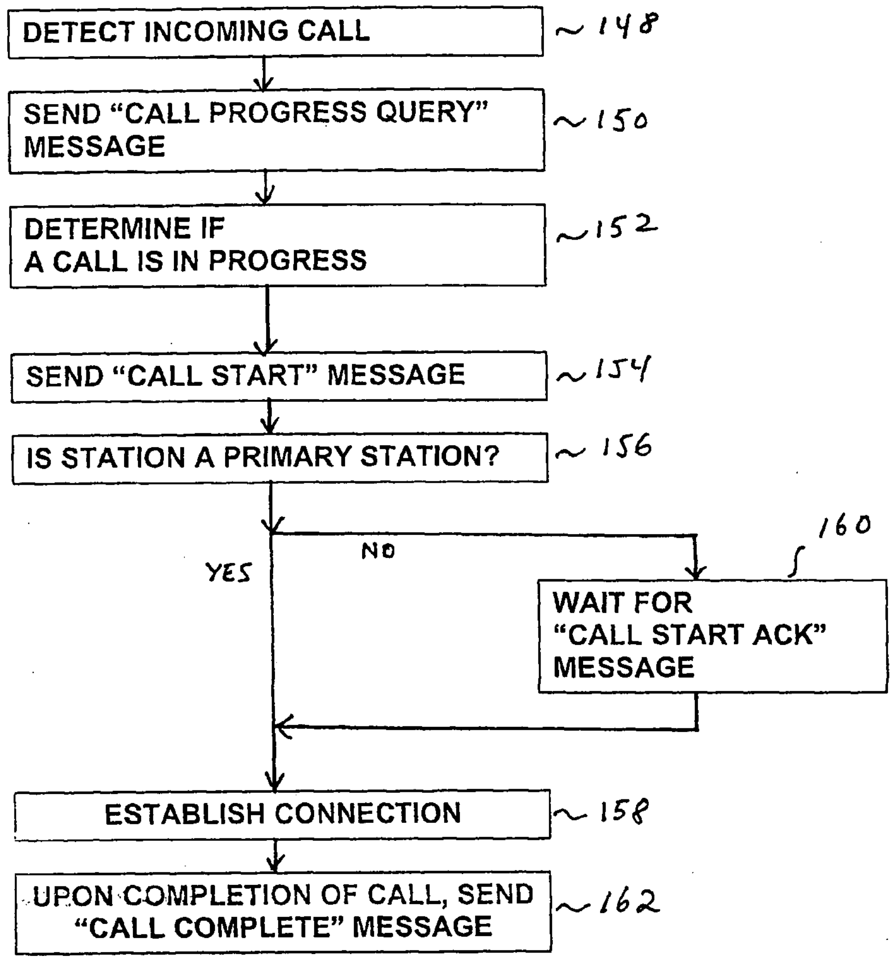

DETECT INCOMING CALL
148
SEND "CALL PROGRESS QUERY" MESSAGE
150
DETERMINE IF A CALL IS IN PROGRESS
152
SEND "CALL START" MESSAGE
154
IS STATION A PRIMARY STATION?
156
YES
NO
160
WAIT FOR "CALL START ACK" MESSAGE
ESTABLISH CONNECTION
158
UPON COMPLETION OF CALL, SEND "CALL COMPLETE" MESSAGE
162

FIG. 8C

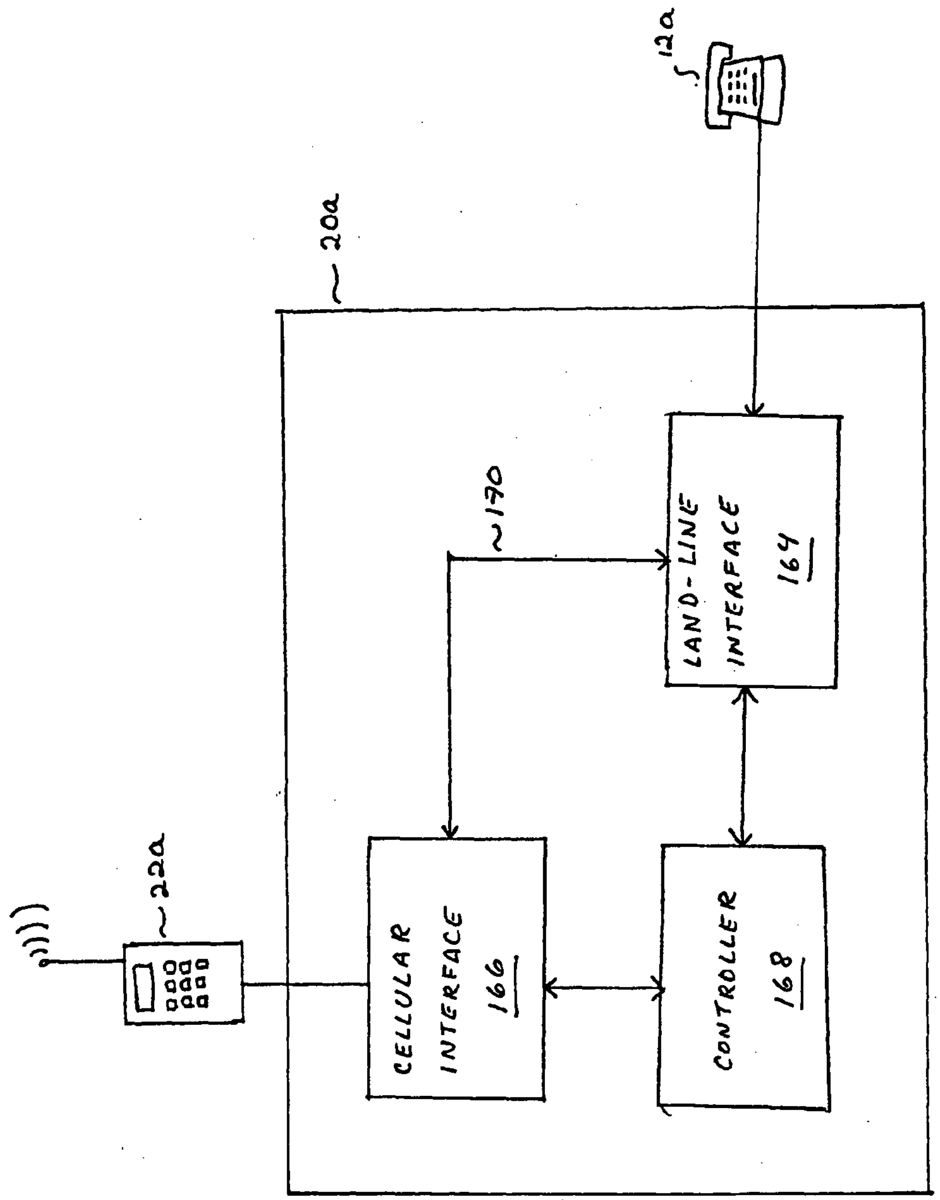

12a
20a
170
LAND-LINE INTERFACE
164
CELLULAR INTERFACE
166
CONTROLLER
168
22a

FIG. 9

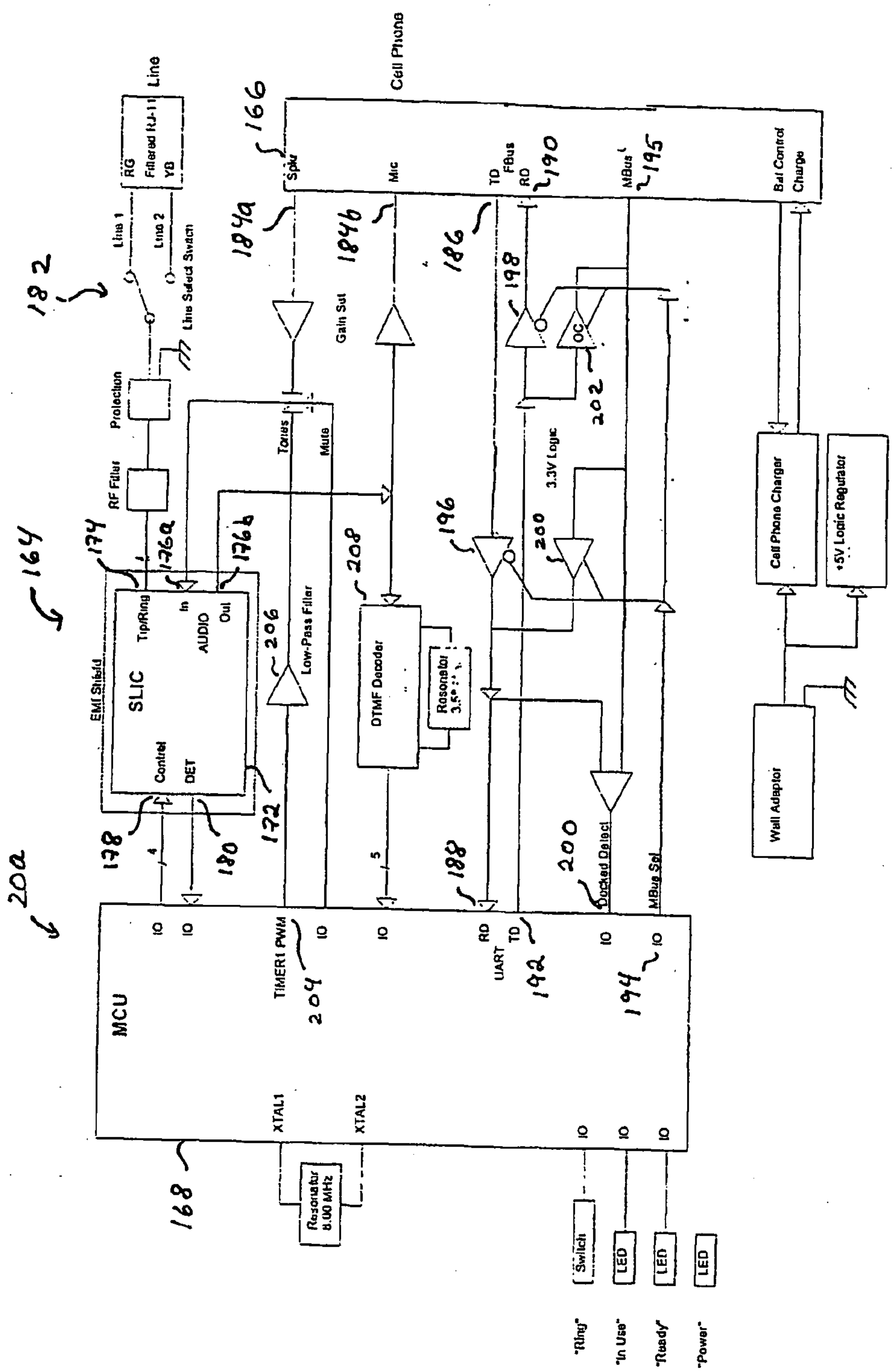

MCU
SLIC
EMI Shield
Tip/Ring
AUDIO
In
Out
Control
DET
RF Filter
Protection
Line Select Switch
Line 1
Line 2
Filtered RJ-11
Line
Cell Phone
Spkr
Mic
TD
FBus
RD
MBus
Bat Control
Charge
Gain Sel
Tones
Mute
Low-Pass Filter
DTMF Decoder
Resonator
3.3V Logic
OC
Docked Detect
MBus Sel
TIMER1 PWM
UART
IO
XTAL1
XTAL2
Resonator 8.00 MHz
Switch
LED
"Ring"
"In Use"
"Ready"
"Power"
Cell Phone Charger
+5V Logic Regulator
Wall Adaptor
164
166
168
172
174
176a
176b
178
180
182
184a
184b
186
188
190
192
194
195
196
198
200
202
204
206
208
202

FIG. 10

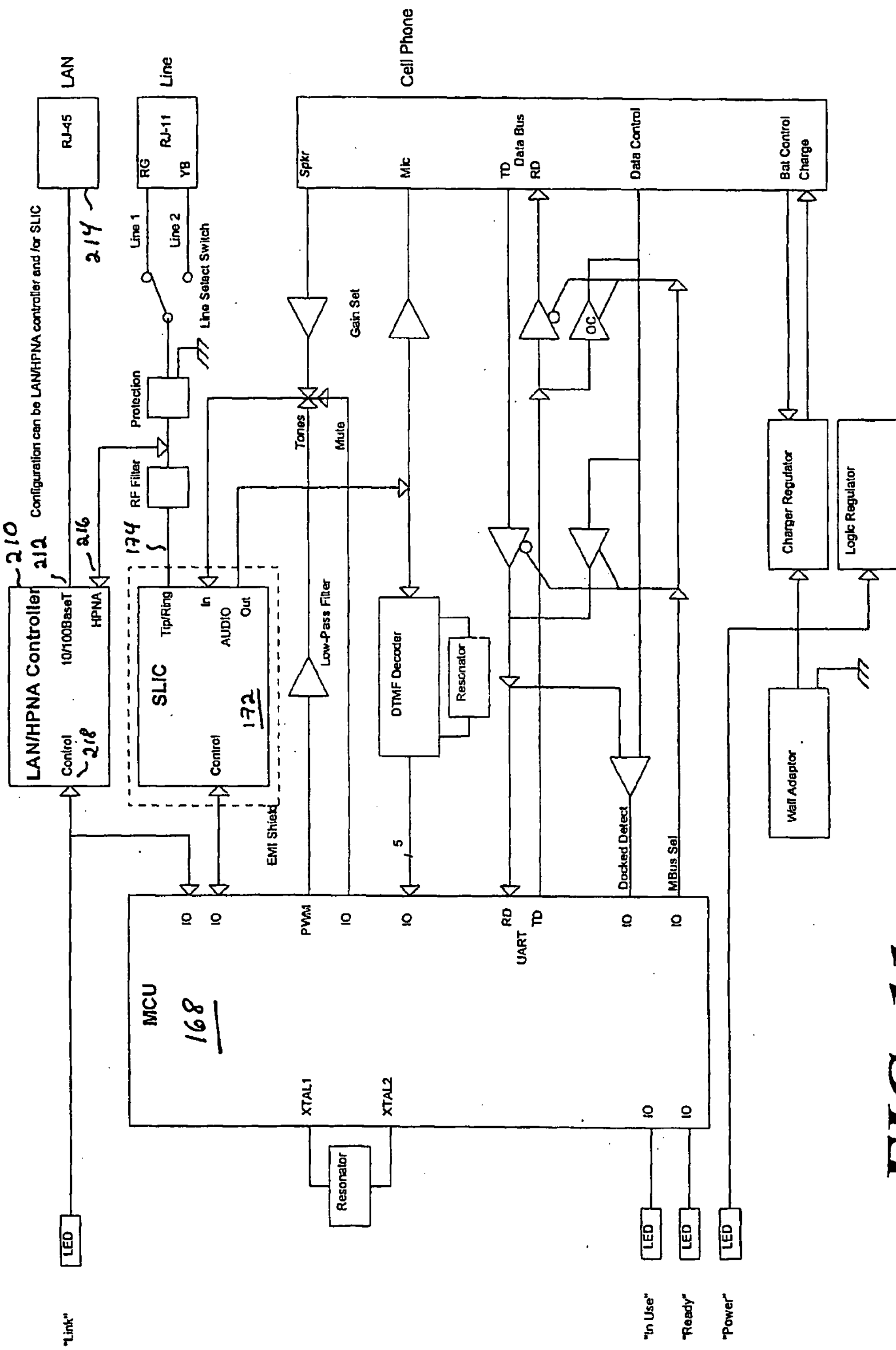

LAN
RJ-45
Line
RJ-11
RG
YB
Line 1
Line 2
Line Select Switch
Cell Phone
Spkr
Mic
TD
Data Bus
RD
Data Control
Bat Control
Charge
Configuration can be LAN/HPNA controller and /or SLIC
214
210
212
216
LAN/HPNA Controller
10/100BaseT
HPNA
Control
218
Protection
RF Filter
174
SLIC
Tip/Ring
In
AUDIO
Out
Control
172
EMI Shield
Tones
Mute
Gain Set
Low-Pass Filter
DTMF Decoder
Resonator
OC
Docked Detect
MBus Sel
Charger Regulator
Logic Regulator
Wall Adaptor
5
MCU
168
IO
PWM
RD
TD
UART
XTAL1
XTAL2
Resonator
LED
"Link"
"In Use"
"Ready"
"Power"

FIG. 11

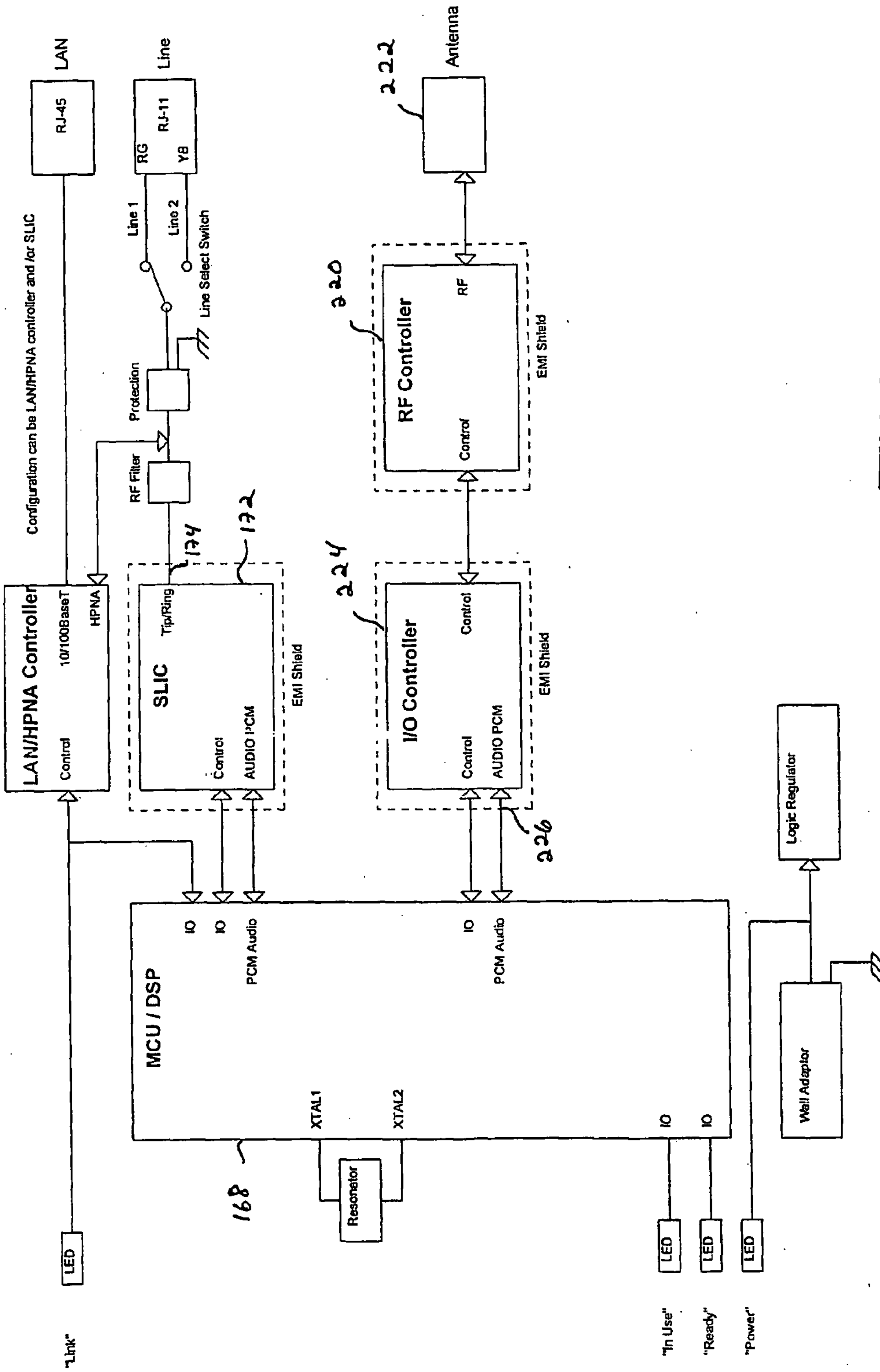

LAN
RJ-45
Line
RG
RJ-11
YB
Line 1
Line 2
Line Select Switch
Protection
RF Filter
Configuration can be LAN/HPNA controller and /or SLIC
LAN/HPNA Controller
Control
10/100BaseT
HPNA
SLIC
Tip/Ring
Control
AUDIO PCM
EMI Shield
174
172
Antenna
222
RF Controller
Control
RF
EMI Shield
220
I/O Controller
Control
Control
AUDIO PCM
EMI Shield
224
226
Logic Regulator
MCU / DSP
IO
IO
PCM Audio
IO
PCM Audio
XTAL1
XTAL2
IO
IO
168
Resonator
Wall Adaptor
LED
LED
LED
LED
"Link"
"In Use"
"Ready"
"Power"

FIG. 12

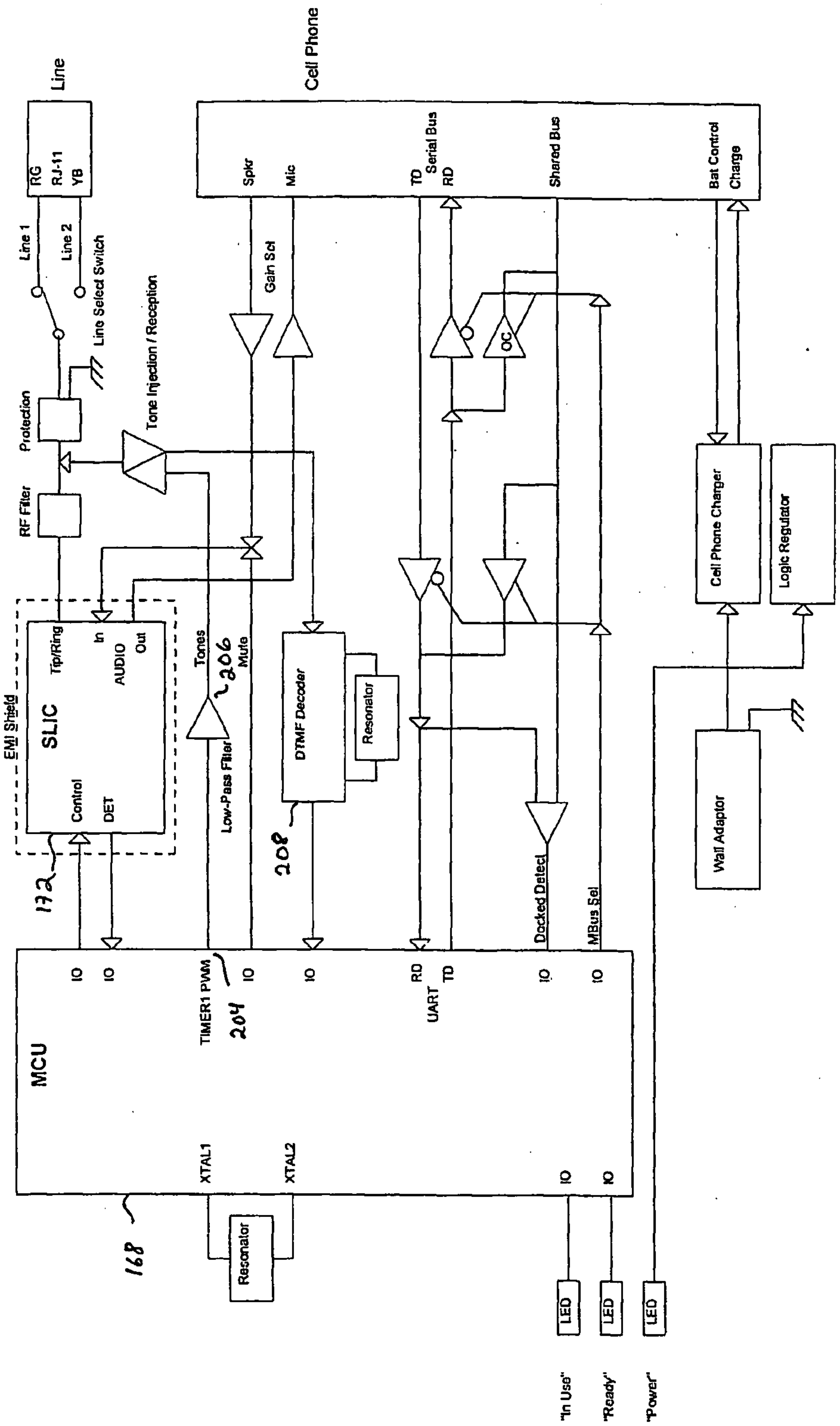

Line
RG
RJ-11
YB
Line 1
Line 2
Line Select Switch
Cell Phone
Spkr
Mic
TD
Serial Bus
RD
Shared Bus
Bat Control
Charge
Gain Sel
OC
Protection
Tone Injection / Reception
RF Filter
EMI Shield
SLIC
Tip/Ring
In
AUDIO
Out
Control
DET
Tones
206
Mute
Low-Pass Filter
DTMF Decoder
Resonator
208
172
Cell Phone Charger
Logic Regulator
Wall Adaptor
Docked Detect
MBus Sel
MCU
IO
TIMER1 PWM
204
RD
UART
TD
XTAL1
XTAL2
Resonator
168
LED
"In Use"
"Ready"
"Power"

FIG. 13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/00310

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :HO4B 1/38 ; HO4Q 7/20, HO4M 9/00
US CL :455/575, 557, 445, 401, 422
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 455/575, 557, 445, 401, 422

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EAST

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,526,403 A (TAM) 11 JUNE 1996, col. 5 lines 19-68, col. 6 lines 1-10, col. 4 lines 44-67, col. 3 lines 25-67, col. 8 lines 49-60,	1-6, 11-18, 20-29
Y	US 5,526,403 A (TAM) 11 JUNE 1996, col. 5 lines 19-68, col. 6 lines 1-10, col. 4 lines 44-67, col. 3 lines 25-67, col. 8 lines 49-60	7-10, 19
A,P	US 6,151,510 A (ZICKER) 21 NOVEMBER 2000, ALL	1-29
A	US 5,924,044 A (VANNATTA ET AL) 13 JULY 1999, ALL	1-29

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 FEBRUARY 2001	18 APR 2001

Name and mailing address of the ISA/US	Authorized officer
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/00310

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6,002,937 A (YOUNG ET AL) 14 DECEMBER 1999, ALL	1-29
Y	US 4,463,647 A (LUCE) 07 AUGUST 1984, ALL	7-10, 19